SMARTMon-UX
User Manual

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SANTOOLS (TM) SMARTMon-UX

Peripheral Monitoring, Tuning, and Reporting Software

1.43 (DEC 2009)

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by David A. Lethe

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SANtools® S.M.A.R.T. Disk Monitor (SMARTMon-UX)

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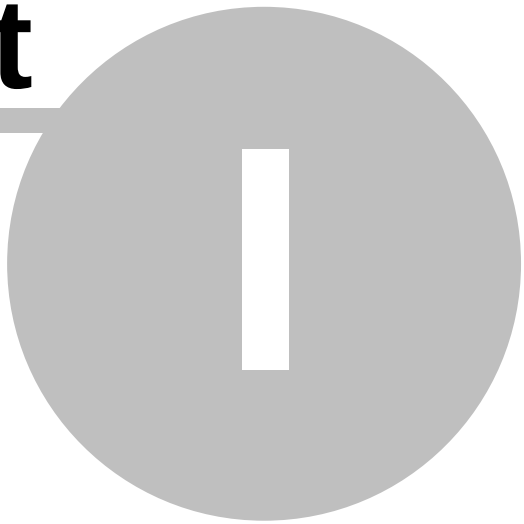

1 Using S.M.A.R.T. Disk Monitor

1.1 General Overview

S.M.A.R.T. Disk Monitor **[Currently at release 1.43]** (also referred to as SMARTMon-UX for UNIX, and SMARTMon for Windows in this document) is part of the SANTOOLS family of utility programs that monitors your disk hardware with the goal of identifying disks that have a strong possibility of crashing. This provides you a window of opportunity to gracefully remove data from a failing disk and take it off-line ... Before your disk drive takes you off-line.

The SANTOOLS family of programs allows you to access the predictive failure functionality native to most disk drives. This hardware feature is called S.M.A.R.T., which stands for Self-Monitoring, Analysis and Reporting Technology. IBM, Seagate, Fujitsu, Quantum, Western Digital, and other drive manufacturers put this feature into their disk drives. Typical attributes that are monitored include head flying height, temperature, spin-up time, retries, and internal error logs. If a drive is running outside of a vendor's specifications, then our software alerts your administrator.

Note: Throughout this manual, when we use the acronym SCSI, we are not implying only ***parallel***-SCSI. Our software works with ***serial*** SCSI devices as well. More common serial SCSI interfaces include Fibre Channel (FC), Serial Storage Architecture (SSA), Serial Attached SCSI (SAS), Fire wire(FW), and iSCSI. In addition, we support SATA / ATA disk drives under LINUX, Windows, Apple OSX, and SPARC Solaris

The same goes for ATA. With the advent of serial ATA, then we must differentiate between ***serial*** ATA (SATA) and ***parallel*** ATA (PATA). Unless we specifically mention SATA or PATA, this manual will just use the ATA acronym.

And finally, this software is not just for disk drives. Many tape drives have a SMART-like feature called TapeAlert 148, which can be enabled and monitored with this software. Intelligent enclosures, auto changers, tape libraries, and even SCSI printers can be configured and monitored with this software. We can even drill down inside several FC-based RAID engines and provide detailed information.

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1.2 Hardware & Software Requirements

Hardware Requirements

SMARTMon-UX supports SCSI, Fibre Channel, USB, Fire wire (IEEE 1384), ATAPI, SAS, and IBM SSA peripherals which are physically connected to your system. It will not monitor or discover remote disk drives attached by a network interface. It will, however, support fibre channel disk drives attached via a storage area network through a hub or switch.

In addition, the LINUX 32, LINUX 64, OS X, SPARC Solaris, and Windows-family operating systems support IDE (ATA & SATA) disk drives.

If you have a fibre channel enclosure that supports SCSI Enclosure Services (SES), SMARTMon-UX can be configured to also monitor the enclosure and it's components.

Software Requirements

SMARTMon-UX for LINUX supports LINUX kernels 2.4 through 2.6. Our LINUX development/test platforms use Red Hat distributions, but there are no known issues with non-Red Hat LINUX distributions. Both 32-bit X86, 64-bit IA64 (Itanium), and EMT_64 (also called X86_64) versions exist. Our test environment for LINUX is RedHat, and while we have no known issues with other LINUX variants, it would be unwise to document that we support all versions of LINUX.

SMARTMon-UX for AIX supports AIX 5.0 and above.

SMARTMon-UX for HP-UX supports HP-UX version 10.x and 11.x using the PA-RISC architecture.

SMARTMon-UX for HP-UX/Itanium supports HP-UX version 11.x on Intel Itanium-family servers.

SMARTMon-UX for SPARC Solaris supports Solaris versions 2.7 and above. (Version 2.6 may still work, but we no longer test on that platform)

SMARTMon-UX for HP's Tru64 requires version 5.1 (but may run on previous versions depending on your hardware).

SMARTMon-UX for i86 Solaris (for Intel and compatible processors) supports Solaris versions 2.7 and above.

SMARTMon-UX for IRIX supports IRIX versions 6.5 and above. It will probably work on previous versions of IRIX, but we have not tested it in older revisions of the operating system.

SMARTMon-UX for UNIXWARE supports UNIXWARE version 7.0 and above. This release is not in general availability.

SMARTMon-UX for Windows™ supports Microsoft Windows(TM) Windows XP, Windows 2003, Vista (32 and 64-bit) and Windows 2008. Windows 7 is under test as of Oct 31 2009.

SMARTMon-UX for 64-bit Windows supports the Itanium and X86_64 builds for 64-bit Windows XP, 64-bit Windows 2003, and 64-bit Vista and Windows 2008.

SMARTMon-UX for Apple OS X supports Version 10.2.3 (Jaguar) and above. In addition, it will only monitor and detect fibre channel devices attached to the Astera Technologies "Rhino" fibre channel HBA, using drivers that were created after January 20th, 2003. IDE (ATA) disk drive support was added in release 1.28. There is no support for SCSI devices.

SMARTMon-UX for Apple OS X (Intel) Supports 10.5.0 and above. This only supports ATA/SATA disks due to Apple's inane stance that prevents vendors from sending pass-through commands to SCSI/Fibre channel peripherals without writing device-specific drivers.

SMARTMon-UX for OpenVMS (originally called VMS) supports VMS 7.2 and above. Versions exist for both the Alpha and Itanium platforms.

Other operating systems will be added, based on end user requests.

Runtime Requirements

As this software can allow administrators to not only monitor their peripherals, but reprogram mode pages, we programmatically require that the software is run from root, or as superuser.

If you are running Windows XP, or 2003, then you must run it from a user with administrative privileges or as a windows service program. (The program will run as a windows service as of release 1.29). The software is UAC-aware.

Apple OS X users may either run the program from root, or use sudo.

The SNIA HBA API Library is supported under AIX, HP-UX, Windows, LINUX, and SPARC Solaris. We bundle two executables with the distribution, one that requires the API to be installed on your host, the other neither uses nor requires it.

1.3 Principles of Operation

General Initialization Phase:

- Test to make sure program is run from root (superuser). If you are running the Windows release, then the test is to make sure you have administrative privileges, or was installed as a windows service.
- Read and parse Command-Line Operations 16. If no list of devices is supplied to the program at invocation, it will launch a discovery to identify all devices that are currently attached.

Device Discovery:

Once the program authenticates the user for sufficient privilege to run the program, it parses the command options. If

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the operator supplies the program with a list of devices to run against, the program builds that list and issues the commands to verify that the devices exist and are not offline. If no list of devices is supplied, the software will initiate a device discovery. This discovery can take several seconds up to over a minute if you have a large UNIX configuration.

If your system's peripheral configuration is rather static, you should bypass the discovery by supplying a list of devices to the program, and modify any scripts you have created to use a hard list of devices.

Device Initialization Phase (IBM AIX):

- The program builds a list of device candidates by issuing "**`lsdev | grep Available | cut -f 1 -d ' ' | grep -e disk -e cd -e sas -e ses`**".

Device Initialization Phase (Apple OS X 10.2.3 and higher):

- This software supports fibre channel devices using the AsteraTech fibre channel HBA only. The drivers must be dated after February 15th, 2003, as that is when they released drivers that communicate with our software. There is no support for SCSI peripherals.
- ATA devices are scanned by enumerating the BSD /dev names. If the device is an IDE (SATA or ATA) disk drive, it will be added to the list for processing.
- We build a numeric list of device candidates by performing direct pass-through calls to the AsteraTech driver, and requesting that it returns information for every fibre channel device it discovers on all controllers and ports. This list is a numeric list that starts from 0.
- As only fibre-channel devices are supported, no scanning for parallel SCSI, fire wire, or ATA devices is performed.

Device Initialization Phase (HP-UX):

- The program builds a list of device candidates by issuing the **`/sbin/ioscan -FknC disk`** and **`/sbin/ioscan -FknC tape`** commands, along with enumerating devices in the **`/dev/rscsi`** directory.

Device Initialization Phase (IRIX):

- The program builds a list of device candidates by searching for **`/hw/scsi`** entries and parsing out the SCSI and fibre channel disk entries which are returned. Then it appends the list with tapes using the wildcard **`/hw/tape/*nrs`**. The program continues in the same way that the LINUX release does, as described earlier in this section.

Device Initialization Phase (LINUX):

- The program builds a list of device candidates by issuing the **`/sbin/sfdisk`** command and parsing out entries beginning with **`/dev/s`**. Then it appends the first SCSI tape device, **`/dev/st0`**. IDE devices are detected by scanning **`/dev/hda`** through **`/dev/hdl`**. *(This is not done if SMARTMon-ux is invoked with a list of specific disks to monitor).*
- For each IDE disk device discovered: (**`/dev/hda`** ... **`/dev/hdl`**)
  - Device information is read and stored.
  - If the disk has S.M.A.R.T. firmware capability, it is enabled. Otherwise the program reports that it cannot enable it for the specific device.
  - Initial S.M.A.R.T. values and thresholds are read to establish a baseline.
  - Drive information is displayed and placed into log file in format specified in command-line operations or defaults.
- For each SCSI (or Fibre channel or SSA device found):
  - Two SCSI Inquiries are issued. The first is a standard inquiry. The second is an inquiry on an optional vendor-specific page to determine the device's unique serial number. *(The SCSI specification unfortunately does not require disks to report a serial number programmatically)*.
  - If the manufacturer is listed as "Promise", the card is an IDE-based Promise RAID controller. SMARTMon-ux issues the vendor-specific commands to extract make model and serial number information for the drives which make the Promise RAID-0 or RAID-1 data set. *(Promise RAID controllers do not support S.M.A.R.T. polling).*
  - If the disk has S.M.A.R.T. firmware capability, it is enabled. Otherwise the program reports that it cannot enable it for the selected device. Note also that SCSI devices support a performance bit which is a S.M.A.R.T. setting that lets the drive run internal S.M.A.R.T. diagnostics without interrupting data flow. If you are in a high-throughput environment such as video streaming, you should invoke this program with the **-P** 19 option.

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Not all disk drives support the performance bit (also known as **PERF** bit). SMARTMon will let the user know if there is a problem setting this value.

- The S.M.A.R.T. polling interval is the internal interval programmed into the disk drive. This is set to 10 minutes, unless changed via the command line option **-F** 18.
- The disk is checked to see if it supports optional SMART and temperature reporting log pages. If so, they are read to establish a baseline.
- Device information is displayed and placed into log file in format specified in command-line operations or defaults. Since SCSI and Fibre channel support devices other than disk drives, all devices discovered are reported. Of course, only disk drives with non-removable media are monitored.
- If a disk supports SES (SCSI Enclosure Services), it marks the drive as one which might be capable of communicating with a SES enclosure, provided the **-E** 37 flag is set.
- *Note: The LINUX operating system has a hard limit of 4KB worth of data that can be sent to a /dev/sd* driver. The 4KB limitation will only affect operations such as reading an extremely long log page (which would typically be vendor/device specific), or reading a long defect list (using the **-Y**) command. If you prefer, as of release 1.21, you can also interact with a peripheral that uses the **/dev/sg** type driver. Our code will allow up to a 64KB transfer, provided your LINUX kernel allows it. We did not design this software to use the sg class driver as LINUX has no reliable method to insure a successful cross-reference to a physical device. Whenever you system boots, it will assign sg class drivers in any order it wishes. We suggest you do not use sg class drivers unless specifically told to use them because a particular command failed.*
- ***(Added in 1.23D) The program now insures I/O will be sent to any device specifically entered on the command-line. This was done to facilitate discovery of devices behind Intel and other's zero-channel RAID cards, which generally report the back-end disks under device /dev/sg type drivers. I.e., if you enter ./smartmon-ux -I /dev/sda /dev/sg0 /dev/sg[3-5], then it will poll /dev/sga, /dev/sg0, /dev/sg3, /dev/sg4, and /dev/sg5. This may result in a duplicate entry as /dev/sda would normally be mapped to /dev/sg0, but this is only way to detect disks masked by a RAID engine.***
- **Important: The LINUX operating system is in process of phasing out support for pass-through SCSI commands to /dev/sd class drivers, so even though this software allows you to perform most actions on a particular device using the /dev/sd class driver, you need to get in habit of using /dev/sg class driver.**

Device Initialization Phase (SPARC and Intel Solaris):

- The program builds a list of device candidates by searching the **/dev/rdsk/*s0**, **/dev/es**, **/dev/osa/dev/rdsk/*s0**, **/dev/rmt/*mn**, **/dev/scsi/*/*** directories and parsing out the SCSI and fibre channel device and enclosure which are valid. It will also report whether a disk is an IDE device, and if it will have to be skipped.

Device Initialization Phase (Tru64):

- The program builds a list of device candidates by searching the wild-cards: **/devices/disk/*disk*a, /devices/disk/cdrom?a, /devices/tape/tape?** and **/devices/changer/?**.

Device Initialization Phase (VMS):

- The program builds a list of device candidates by issuing the **SHOW DEVICES** command, then tossing any device that has a "**$**" character in it. Then it examines the remaining entries and ignores them unless they show as having an **online** or **mounted** state.

Device Initialization Phase (Microsoft Windows® family operating systems):

- The program searches for assigned physical disks at **\\.\PHYSICALDRIVE0** through **\\.\PHYSICALDRIVE127**. This will result in discovering all disk drives which have been assigned a drive letter. It then searches for unconfigured devices by searching the list of **\\.\SCSI0 - \\.\SCSI16**. Other devices are discovered **\\.\TAPE0 - \\.\TAPE15**, **\\.\SCANNER0** - **\\.\SCANNER7**, then **\\.\CDROM0** ..**\\.\CDROM15**.
- We addressed a serious bug that prevented some devices from being discovered if attached to Emulex LP9002, and some JNI HBAs, depending on the driver levels. The problem was that these controllers/drivers might map more than one device to a **\\.\SCSI** type driver. Because of this, we now also query the host adapters to discover devices under all ports, paths, IDs, and LUNs for a particular **\\.\SCSI** class driver. A device appearing on SCSI2 at Port2, target ID 18, LUN 3 and path0 would be referenced as **\\.\SCSI2Port2Path0Target18Lun3.** Please see the device naming conventions 235 topic for additional details.

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- If the O/S indicates there are LUNs, then they are added to the device list as well.
- Finally IDE disks and ATAPI (CDROMs) are discovered and added to the table if found.
- UAC and appropriate manifest information was added in 1.35 to insure native compatibility with Windows Vista and Windows 2008.

Device Polling:

After all devices have been discovered, they will be polled at a configurable interval. If none is supplied, all disks will be polled every 10 minutes. This is the recommended value defined by the S.M.A.R.T. specification. IDE drives are polled first (if LINUX), then the SCSI disks. Tapes or devices with removable medium are not polled. In the case of IDE disk drives, SMARTMon requests the status result of the internal S.M.A.R.T. diagnostic registers that are constantly being updated during idle times and I/Os by the disk drives themselves. *SMARTMon-UX does NOT instruct the disk to run a diagnostic test at the current polling interval. It asks the IDE disk what it's S.M.A.R.T. status is at the time of the poll.*

If the device is not an IDE disk, SMARTMon-UX instructs the disk drive to read a block of data into the bit bucket to initiate a S.M.A.R.T. error notification. It also checks the SMART log page and temperature pages, if the disk is equipped with them.

If an error is found (which would indicate a degrading condition, and impending drive failure), a message is logged in the system log file, `/vary/log/messages`, using the standard UNIX syslog facility. In addition, if EMAIL is enabled and configured on your LINUX system, an email is sent to the address specified. *If the operator invoked SMARTMon-UX with the -L option, these messages will be found in the file, `/vary/log/smartmon-ux`.*

If no errors are found, an S.M.A.R.T. test passed message is logged to syslog as well. All messages contain a time-date stamp, and reference `smartmon-ux` as the program creating the message.

SES Enclosure Polling:

If the device is in an SES enclosure (applicable to fibre channel host-attached enclosures only), the program must first determine if it may be used to communicate with the SES electronics embedded in the intelligent enclosure. This must be done because not all disks may have this capability, as defined by the particular make and model of enclosure.

If SMARTMon determines that the selected device can not communicate with the enclosure, it marks the drive accordingly, and it does not attempt to communicate again.

If the disk can access the SES status registers, the software retrieves them and parses status information. If the status shows there is a problem, the software reports the problem in the manner selected by the software's installer.

SES polling will only be done if the **-E** command-line option is specified on the command line.

SAF-TE Enclosure Polling:

SAF-TE enclosures will always have a unique SCSI ID and LUN associated with them and appear as a SCSI processor type device. If SMARTMon determines that the device is a processor-type, it will determine if it is a SAF-TE enclosure by sending the appropriate commands and parse the output.

If SMARTMon determines that the selected device is a SAF-TE enclosure, it will mark it as pollable and will poll it if the -E option is specified on the command line. Otherwise the device will not be polled.

SAF-TE polling will only be done if the **-E** command-line option is specified on the command line.

Threshold Monitoring:

When the program is invoked with the **-W** option, and a corresponding user-defined threshold file, it loads them into the program's memory so they will not have to be re-loaded. As thresholds are loaded, the program determines the minimum common polling frequency to examine thresholds. (See Threshold Monitoring 158 and Threshold Configuration 158 sections for details).

At the defined polling period, the program scans through the list of thresholds for a device that needs polling and is on-line. It issues a Log Sense command to the device for the page holding the required information. The resulting

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value is compared against the user-defined threshold. If the value read is ***greater than or equal to*** the threshold, the appropriate action (email, event log, and/or user-defined script) is taken.

The process continues until all thresholds have been examined. The program sleeps until the next polling period.

Windows Service Program Startup
As of release 1.29, the windows version of the software can be installed and run as a standard NT service program which, by default, will be configured to auto-launch at boot time.

1.3.1 Return Codes

SMARTMon-UX has standardized return codes (Windows users may know them better as **error levels**) that are returned to a calling program as the program exits. The codes are as follows:

Number	Name	Description
0	NORMAL_RETURN	Normal return code if no problems found with command.
1	FATAL_EXIT	Generic exit code indicating command syntax error.
2	INVALID_PARAM	Syntax error, but denotes invalid parameter for a command.
3	UNSUPPORTED	Command unsupported for the selected device.
4	INSUFFICIENT	Insufficient O/S resources to perform desired action.
5	TEST_MESSAGE	Test error message generated.
6	EMAIL_UNCONF	Email attempted, but settings not configured properly.
10	SCRUB_C_ERROR	Scrub-family test completed, but with errors.
11	SCRUB_T_ERR	Scrub-family test terminated early due to error(s).
12	SCRUB_T_NOTUNIQ	Scrub-family test terminated, pattern on disk is not random, disk has not been erased
13	WS_TERMINATED_ERR	Write same command terminated with errors
15	TERMINATED	Similar to INVALID_PARAM, but parameters were determined to be invalid at runtime
20	SERVICE_ERR	Windows-specific service routine general error.
21	TERMINATED_UNSAN	Terminated, command not supported on a SANtool device
22	ABORTEDBYUSER	Action terminated by user (CTRL-C or killed, or quit)
23	CEMI_FLASHCHECK	Used specifically for Xyratex enclosures in event SES firmware image is rejected.
24	TERMINATED_OPERATOR	(Reserved for use with SANtool)
25	TERMINATED_SIGNAL	Catch-all return code if program exits due to a reason other than above
26	EXITED_FLOATINGPOINT	(Reserved in event host/OS has floating point library error) - Please contact SANtools if this error appears.
33	TERMINATED_SAN	Terminated, program unsupported on this hardware
254	SANTOOLS_CODE_1	Indicates programmer error. This is an error you should never get, but if you do, please forward it to us immediately.
255	SANTOOLS_CODE_2	Indicates programmer error. This is an error you should never get, but if you do, please forward it to us immediately.

These return codes are of value if you script SMARTMon-UX and wish to implement conditional logic based on their values. See the documentation on the **-scrub** 120 family of commands to see the return codes that are passed back to the calling program in response to the **command-line options** 16 sent to the peripheral(s).

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1.4 Installing & Configuring

To install the program under a UNIX or LINUX operating system:

1. Log in as root. (If you are on an apple, you may also just preface the below commands with **sudo**).
2. Enter **mkdir <target directory>** For purposes of example, we will assume you have set the target directory to be **/tmp/SMARTMon-UX**.
3. Enter **cd /tmp/SMARTMon-UX**
4. Enter **tar xvf SMARTMon-UX.tar**
5. Enter **rm SMARTMon-UX.tar**

At this point, your program is extracted and now needs to be *configured* so it will automatically run at boot time. To do this, enter **./configure** at the prompt. This script performs the following:

- Sets file permissions.
- Copies the program image to **/etc/smartmon-ux**, the designated program location.
- Asks you where you want to optionally install this HTML documentation.
- Asks you if you want to make the software automatically start at boot time, and if so, runs you through your desired configuration options.

If you plan on using the EMAIL facility, you should test it first. If your email address was **david@xyz.com**, invoke SMARTMon-UX with **smartmon-ux -T david@xyz.com**

If your host has email properly configured, you would receive a test message. If you do not receive it, please contact your UNIX system administrator and have him/her assist you with configuring email services.

If you are running LINUX, you would use the **linuxconf** command. Then click on the *sendmail configuration section*, and follow the prompts. If you need assistance configuring sendmail, you should view one of the many tutorials and FAQ's on the http://www.redhat.com site.

Other operating systems have web-based tutorials and mail configuration scripts as well.

To install the program under Windows family operating systems:

This software is light-weight and does not use an installer. By convention, copy the executable to **\Program Files\SANtools\SMARTMonUX** subdirectory. The license file, **.smartmon-uxlicense.txt** that accompanies your build must be copied to the same directory. Once the two files have been copied, launch a MS-DOS command window and enter, smartmon-ux -I. This will instruct the program to scan and report connected peripherals, and load the value in the license file into your registry. Once that has been done, you are free to run the software from any mounted device your computer can access.

Note that there IS a leading period in the license file.

To install the program under VMS / OpenVMS:

Copy the program to any directory on the system that has system privileges, along with the your license key file SMARTMON.LIC.

1.4.1 SMTP Mail Server Configuration

This feature is specific for Windows family operating systems. If you are using a UNIX or LINUX variant of the software, you need only to configure sendmail, postfix, or whatever default mailer you have on the system. That is because the UNIX/LINUX variants send mail by simply launching the mail or mailx program and passing it the subject, message, and email address(es).

Configuration Commands

When you launch the program with the **-Mail** option (**smartmon-ux -Mail**), it returns with a list of options. The program will not launch into the background, and it will not monitor hardware. The purpose of this mode is to provide a means to have the program manage mail account settings, which are stored in the system registry. The program will

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terminate once the user has exited this function.

This section of the documentation makes frequent use of screen snapshots. All computer-generated output is shown in blue, and all entered text is shown in red.

```
# smartmon-ux -Mail

Command (Enter ? for help): ?
  ?: Help
  S: Select mail server account
  A: Add new mail server account
  V: View all mail server accounts
  U: Unconfigure selected mail server account
  M: Modify settings for selected mail server account
  D: Define default mail server account when running smartmon-ux as a service
  Q: Quit and exit program

Command (Enter ? for help):
```

Option S - Select Mail Server Account

This function is used to select a configured SMTP server from a list of available servers. The selected server will be marked by an '*'. This function does nothing unless there are at least two servers defined. The program does not allow you to select an account that is numerically out-of-range.

Option V - View all Mail Server Accounts

This displays all defined thresholds for all devices. The devices do not have to be on-line or attached to your system. However, if they are not attached to your system, you will not be able to make any modifications to them.

```
Command (Enter ? for help): V
ID  SMTPServer                    EMAIL Address
--- ----------------------------- --------------------
* 0 smtp.xyz.com                  fred@xyz.com (Configured)
  1 smtp.myhomeaccount.com        a342@myhomeaccount.com
  2 smtp.myhomeaccount.com        a342@myhomeaccount.com
  3 smtp.xyz.local                fred@xyz.local (Configured)

Command (Enter ? for help): S
Select Device (0) : 1
This SMTP server an account is NOT configured.
```

Note that the (*) indicates the currently selected device. By default, the first discovered device will always be selected.

An EMAIL account is configured once all of the keys and strings defined by the registry settings 10 table have been entered. If the particular account requires authentication, you will not be able to send mail to the desired SMTP server, unless you configure it with the Modify Settings 9 function.

Option U - Unconfigure Selected Mail Server Account

If the mail server account was added by this software, this function will remove the settings completely from the registry. If, however, the account was already in the registry and associated with some other mail package like Outlook, only the registry entries shown in the table 10 will be removed. This will not affect the operation of other email programs.

Option M - Modify Settings for Selected Mail Server

While you can change authentication-related information, you are not allowed to change the mail server with this function. The selected server is the one that is marked with the '*' as shown in the view all mail servers 9 function. The default value is shown to the right of the field prompt.

If you enter "none" for the SMTP Authorization type field, this will instruct the software that this email server does not need user name/password authentication.

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```
Command (Enter ? for help): M
SMTP Server (example: smtp.xyzcorp.com) () : smtp.xyz.com
SMTP mail port (25) : 25
Your email address (example: david@xyzcorp.com) (fred@xyz.com) : fred2@xyz.com
SMTP Authorization type (plain, md5-cram ,login, or none) (login) :
SMTP server user name (fred) :
SMTP server password (asfg2ls&&) :

Are you sure (Enter Y to save new settings, Q to quit, anything else to re-enter changes: Y
```

Option A - Add New Mail Server Account

The text blow shows what would typically have to be entered to create a new SMTP account.

```
Command (Enter ? for help): A
Enter email server and account information below. Your sysadmin should know the proper settings to use.
SMTP Server (example: smtp.xyzcorp.com) (smtp.myisp.com) : smtp.stealthmailer.com
SMTP mail port (25) : 25
SMTP Authentication type (plain, md5-cram ,login, or none) () : login
SMTP server authentication user name, RETURN to leave blank () : jerry
SMTP server authentication password, RETURN to leave blank () : yadayada
Your email address (example: jerry@xyzcorp.com) () : jerry@stealthmailer.com

Are you sure (Enter Y or y, anything else lets you try again):
```

Option D - Define default Mail Server Account when Running as a Service

The text blow shows what would typically have to be entered to create a new SMTP account.

Frequently Asked Questions

1. What are the registry settings, and can I make them manually?

The software makes the following registry additions under HKEY_CURRENT_USER using the key **\SOFTWARE\Microsoft\Internet Account Manager\Accounts\000000nn**, where hh is a 2-character hex number ranging from 00 to 40 decimal. As this is the same place where Microsoft Outlook and other programs store email account information, the program can typically pick up some good default information.

The new values except SMTP Port are all defined as type REG_SZ (string value) and are shown in the table below. SMTP Port is defined as REG_DWORD

Field Name	Usage	Example
SMARTMON-A	Authentication Method (plain, none, md5-cram, or login)	**login**
SMARTMON-C	Y or N, depending on whether or not account configured & active	**Y**
SMARTMON-U	User name required for email servers that require authentication	**johnsdi1**
SMARTMON-P	Password required for email servers that require authentication	**pencil**
SMTP Email Address	Valid email address that is where messages will be "from".	**john@xyz.com**
SMTP Port	SMTP port number required by mail server	**0x00000019 (25)**
SMTP Server	Fully qualified domain and machine name of mail server	**smtp.xyz.com**

If the particular SMTP server account you are using already exists in the registry, the fields required by SANTOOLS will be added. The new fields will not affect any email accounts you may already have set up on your machine, but if you delete email accounts that have later been configured with the -Mail option, you should run the -Mail function again to make any necessary changes.

2. How do you instruct the program to use the appropriate mail server account?

Invoke the program with the **-N** 19 option to select the appropriate SMTP account. If you have more than one email account on your machine for a given SMTP server, the program will use the FIRST match it finds in the registry.

3. Must accounts be marked as "configured"?

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Generally this is the case. Unless you use this function to select and modify email servers and accounts, the email server may reject the message.

4. What happens if there are more than one email accounts set up for a particular SMTP server?
The software will use the first entry (lowest number) it finds that matches the SMTP server which was supplied via the command-line when the program was launched.

5. Does the software do any validation of settings before attempting to send mail?
No. You may, however, test the E-Mail settings after you have set up the account by using the -T function 11 to generate a sample alert.

1.4.2 Testing Predictive Failure Alerts and Actions

In the event of a disk-related predictive failure, the program initiates the following actions in this order:

1. It sends a message in your host operating systems's standard event log. If you invoked the program with the **-L** 19 option, the message is appended to a flat text file instead.
2. If you invoked the program with the **-M** 19 option, the software will send the event information to the appropriate email address that was supplied with the **-M** command. Windows users will also need to pre-configure the SMTP settings by using the **-Mail** 9 command, and also supply the -N flag on the command-line which specifies the IP name of the mail server you wish to use. UNIX//LINUX users need not worry about specifying the SMTP server on the command-line. This is because the software invokes the standard mail or mailx program on your host O/S, which uses the default SMTP server that was configured by your system administrator.
3. If the **-LB** 13 option was added to the command-line, the final step is that the software launches the program or script or batch (.BAT) file that was supplied with the -LB command. It passes that file information about the physical device name, make/model information, and the event log data. Your application can either use or ignore that information. It is important to note that smartmon-ux will SUSPEND itself until the program completes. For testing purposes, you should use a simple program that returns quickly and makes it quite obvious that it worked.

You may concurrently test email, event logging, and auto launch programs by appending the -T command with any combination of **-M**, **-L**, and **-LB** flags.

Testing E-MAIL Configuration (Windows Users Only)

If you are running a Windows-family operating system, you must first configure the SMTP E-Mail settings by using the **-Mail** 8 command. This function is an interactive one that will allow you to add/change/unconfigure email accounts on your system.

Once you have configured the settings, send a test message by entering something like:

```
smartmon-ux -T somebody@somewhere.com -N smtp.yourcompany.com
```

somebody@somewhere.com is who you want to send the message to, and **smtp.yourcompany.com** is the IP name of the mail server that your system administrator has set up to use.
If there is an error, an appropriate message will usually be returned which can assist with resolving the problem.

Here are some sample error messages. Note, if you add a physical device path to a disk drive, this will prevent your host from scanning and reporting all physical devices on your system before testing mail.

```
C:\Program Files\SANTOOLS>smartmon-ux -T bogusaddress@mycompany.com -N invalidipname.mycompany.com
SMARTMon-ux [Release 1.29, Build  4-AUG-2005] - Copyright 2001-2005 SANtools, Inc. http://www.SANtools.com
Fatal error from smartmon-ux recorded at 8/4/2005 19:15:23 PM
Program Halted.
You have supplied a SMTP server but have not configured the settings. Enter smartmon-ux -Mail to configure
it.


C:\Program Files\SANTOOLS>smartmon-ux -T myemailaddress@mycompany.com -N smtp.mycompany.com
\\.\PHYSICALDRIVE0
SMARTMon-ux [Release 1.29, Build 4-AUG-2005] - Copyright 2001-2005 SANtools, Inc. http://www.SANtools.com
Discovered HITACHI_DK23EA-60 S/N "JP7348" on \\.\PhysicalDrive0 (SMART Enabled)
```

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```
\\.\PhysicalDrive0 polled at Thu Aug 04 19:20:52 2005 Status:FAILED - Failure imminent (THIS IS A TEST)
No response from SMTP server smtp.mycompany.com


C:\Program Files\SANTOOLS>smartmon-ux -T david@santools.com -N smtp.sanmanager.local \\.\PHYSICALDRIVE0
SMARTMon-ux [Release 1.29, Build  6-AUG-2005] - Copyright 2001-2005 SANtools, Inc. http://www.SANtools.com
Discovered HITACHI_DK23EA-60 S/N "JP7348" on \\.\PhysicalDrive0 (SMART Enabled)
\\.\PhysicalDrive0 polled at Sat Aug 06 23:22:13 2005 Status:FAILED - Failure imminent (THIS IS A TEST)
SMTP Error "SMTP server error response" 535 5.7.3 Authentication unsuccessful.
```

Some problems may never get back to you like if you sent a message to a non-existent email address. This is because many system administrators no longer send bounce-back messages due to the abuses of spammers. It may also take up to 60 seconds for an error message to come back, depending on the type of problem you have and mail server settings.

Testing E-MAIL Configuration (UNIX/LINUX and non-Windows Operating Systems)

SMARTMON-UX sends messages by passing them to a native mailer which does all of the work. This mail program is called **`mailx`** on Solaris, HP/UX, IRIX, TRU64 and FreeBSD. Solaris, AIX, LINUX, UNIXWARE, and OS X use the program **`mail`**. Your operating system must first be configured to work with these programs.

Consult your operating system's documentation for the proper use of mail and mailx, and send a test message using this program. If the test message is successfully received, you can try to send a message from within SMARTMon-UX .

Enter:
`/etc/smartmon-ux -T somebody@somewhere.com` (substitute the email address with your own) and you should receive the message. Note that only windows users have to use the **-N** 19 flag to specify a mail server.

Testing Auto-Launch Program

In order to test the program's ability to spawn a program in the event of a predictive failure, invoke the program with the **-T** option, and add **-LB ProgramName** 13 where you substitute **ProgramName** for your application. As SMARTMon-UX passes the auto-launch program parameters, you should test to see that they are being interpreted correctly.

Auto launch Test Batch File (Windows)

1. Create the file **`c:\Program Files\Scratch Directory\MyApplicationTest.bat`** with the following content:

```
@echo off
echo Successfully launched %0
echo Parameter#1 = %1
echo Parameter#2 = %2
echo Parameter#3 = %3
echo Parameter#4 = %4
echo Returning with exit code 1234
exit 1234
```

2. **`CD`** to where the program was installed.

3. (Optional) Enter **`smartmon-ux -T -LB C:\Program Files\Scratch Directory\MyApplicationTest`**
You will get an error message that tells you to use the short filename for the auto launch program because of the imbedded space you have in "**`Program Files`**". The message will also tell you to use the **`DIR /X`** command to learn the short file name.

4. Enter **`smartmon-ux -T -LB C:\Progra~1\Scratch Directory\MyApplicationTest.bat`**
The output should be similar to:

```
C:\Program Files\SMARTMon>smartmon-ux -T -LB C:\Progra~1\Scratch Directory\MyApplicationTest.bat
SMARTMon-ux [Release 1.29, Build  6-AUG-2005] - Copyright 2001-2005 SANtools, Inc. http://www.SANtools.com
Discovered HITACHI_DK23EA-60 S/N "JP7348" on \\.\PhysicalDrive0 (SMART Enabled)
\\.\PhysicalDrive0 polled at Sat Aug 06 13:59:07 2005 Status:FAILED - Failure imminent (THIS IS A TEST)
Successfully launched D:\Progra~1\Scratch Directory\MyApplicationTest.BAT
Parameter#1 = "\\.\PhysicalDrive0"
```

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```
Parameter#2 = "HITACHI_DK23EA-60"
Parameter#3 = "JP73338"
Parameter#4 = "\\.\PhysicalDrive0 polled at Sat Aug 06 13:59:07 2005 Status:FAILED - Failure imminent (THIS
IS A TEST)"
Returning with exit code 1234

Launched batch file "C:\Progra~1\Scratch Directory\MyApplicationTest.BAT" which returned user-defined value
1234
C:\Program Files\SMARTMon>
```

You will note that the path, make/model of the "defective" disk, serial number, and full text message is passed to the MyApplicationTest batch file, along with the return code. SMARTMon-UX currently ignores he return code, except in cases where the program failed to launch.

Auto launch Test Batch File (UNIX Family)

The process test is similar to windows.
1. Create a test file called **`/tmp/MyApplicationTest.sh`** The contents can be:

```
#!/bin/sh
echo "Parameter#1 =" "$1"
echo "Parameter#1 =" "$2"
echo "Parameter#1 =" "$3"
echo "Parameter#1 =" "$4"
exit 1234
```

2. Enter **`chmod 744 /tmp/MyApplicationTest.sh`**
3. Enter **`/etc/smartmon-ux -T -LB /tmp/MyApplicationTest.sh`**

The **`MyApplicationTest.sh`** script will execute in the same manner as the windows batch file, and return similar output.

Testing Event Log Entries

If you invoke the program with both the **-T** and the **-L** flag, a sample alert message will be logged to the smartmon-ux flat log file 19. Otherwise, the software will log a test message in the standard Application Event Log on Windows machines or via the standard syslog mechanism.

1.4.3 Auto-Launching Program After Predictive Failure

This feature, introduced in build 1.29, allows you to specify a program and path that will be launched in the event of a predictive drive failure (S.M.A.R.T. Error).

In order to specify the program you wish to launch, add to the command-line, **`-LB ProgramName`**, where ***ProgramName*** is the fully qualified file name of the program or script/batch file that you wish to launch. SMARTMon-UX will suspend processing until this program either completes or is terminated. (This is by design, as it prevents a predictive failure on subsequent polling cycles to re-launch the same script in perpetuity).

Auto-Launch Parameters Passed to Spawned Process

SMARTMon-UX will supply the auto-launch program several variables which can be used to control the action of the desired program. The parameters are, in order:

1. Physical Device Path **`("\\.\PhysicalDrive0", "/dev/sd0",`** or anything else appropriate for your O/S**`)`**
2. Make/Model of Disk **`("HITACHI_DK23EA-60")`**
3. Serial Number of Disk **`("JP73339")`**
4. Full error/warning message**`("\\.\PhysicalDrive0 polled at Sat Aug 06 13:59:07 2005 Status:FAILED - Failure imminent")`**

Implementation Note

If your auto-launch program is something that takes considerable time and overhead, like a backup program, you would want to insure that the backup program is not run again during the next polling cycle. In order to prevent this, you may wish to terminate a successful backup with a command that requires operator intervention or just terminates smartmon-ux. For example, Windows users might wish to end the auto-launch program with the PAUSE command

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which suspends processing of a script and waits for keyboard input. (The shell script equivalent of PAUSE is read). As this prevents your script from completing without operator intervention, it suspends SMARTMon-UX as well.

Instructions and sample output for testing the autolaunch program 12 can be found in the Auto-Launching Program After Predictive Failure Section 13

You may combine this auto-launch feature with other alerting mechanisms, such as the -M to send out E-Mail alerts and the -L option that facilitates saving event information in a flat file.

Testing Auto-Launch
Please consult the chapter, Testing Predictive Failure Alerts and Actions 11.

1.4.4 Running as a Windows Service

Release 1.29 introduced the ability to run the program and be managed as a standard Windows Service. When the executable is invoked from the command-line prompt, it runs as a foreground application and sends all output to the screen. When it is invoked from the Service Control Manager plug-in, as shown below, it can be launched as a service routine. All monitoring information will normally be sent to the windows event log.

Service Management Functions
These functions manage the service routine. These functions should not be combined with other functions. All of these functions return to the command-line prompt after they are executed.

Command	Description
-servicehelp	Displays help text specific to these functions
-serviceinstall	This both installs the program as a standard system service and launches the application. If the application is already installed, the service will be started. It will not re-install another executable as a service. If you need to perform a re-install, you must first issue -servicestop 14 to stop the service followed by a -serviceuninstall 14. Then you may install the service.
-serviceuninstall	This stops the service (if running), then uninstalls it.
-serviceparameters [argument list]	Use the argument list to define the commands that the service routine will use when it is launched as a service. This command should be run before you install the service, but it can be entered at any time. The argument list will only be used when the service starts. If you change the parameters, you must restart the program. It is important to note that the program does not perform any syntax checking or validation of parameters when running the -serviceparameters function. You should enter -servicestatus a few minutes after launching the program to make sure that it is running.
-servicestop	This stops the service. You must issue the -servicestart 14 to restart (or use the SCM Plugin 15 to restart the service).
-servicestart	This starts the service and instructs it to use the default parameters defined in the -serviceparameters 14 function.
-servicestatus	Reports status of the service routine (running, stopped, etc ...).

Step-by-Step - Launching the Service
1. Decide on the runtime parameters. This example sets parameters to poll all hardware every 5 minutes, suppress event log entries if no errors are found, and send out an email to support@abc.com using the mail server smtp.abc.com.
2. Configure authentication and mail server settings using the interactive command, -Mail 9. Do this by entering smartmon-ux -Mail 8 and configuring the settings.
3. Enter **`smartmon-ux -serviceparameters -F 300 -sq -M support@abc.com -N smtp.abc.com`**

At this point the service will be installed and running. If this is the first time you have used a certain set of parameters,

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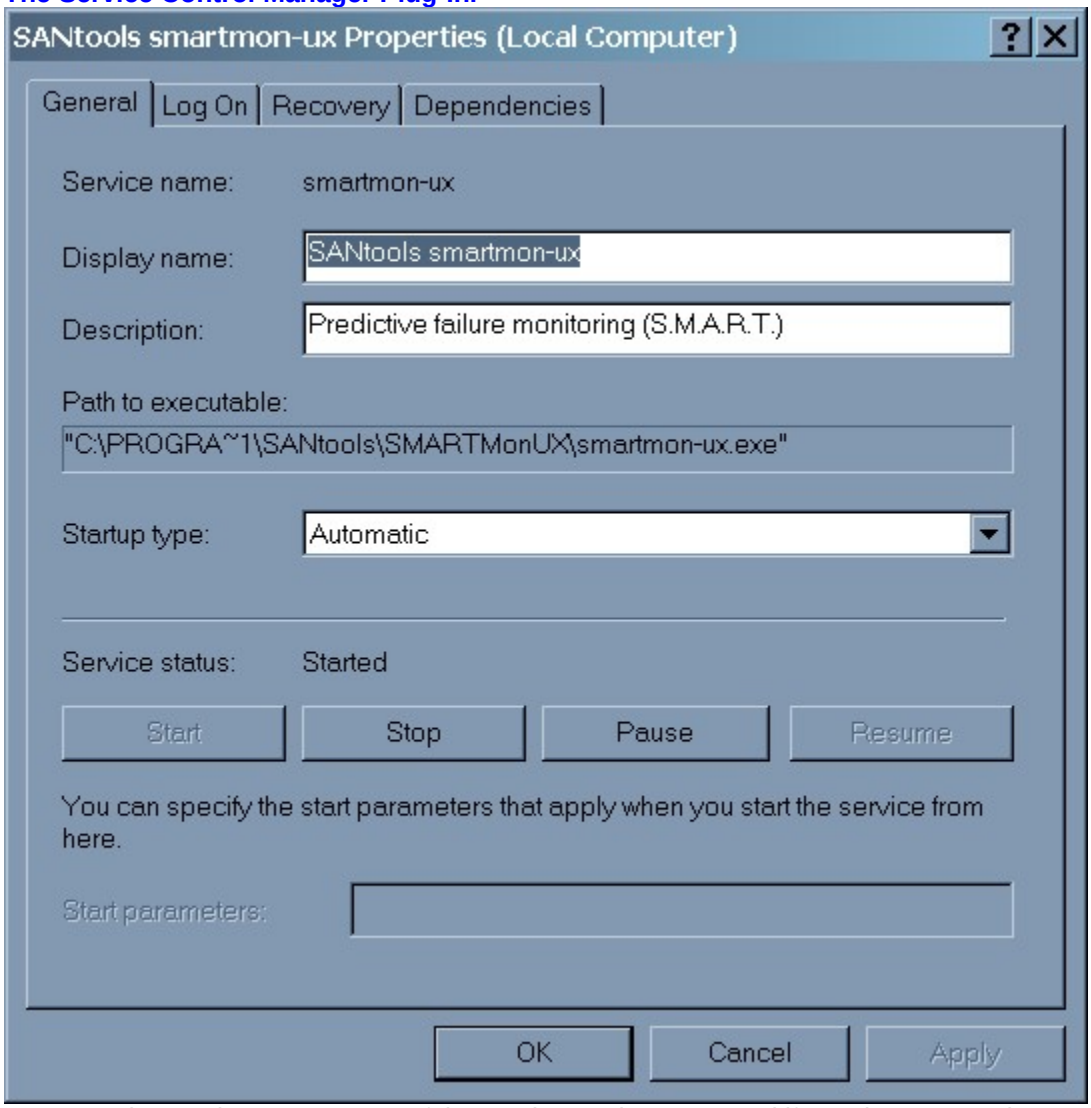
then you should check the windows event log to make sure that the program accepted the parameters and is running as expected.

Parameters Supported when Running as a Service

Most of the polling commands are supported. These include -E, -F, -G, -i -link -L -LRemote -sq -M, -ping -X, and -zm.

The Service Control Manager Plug-In.



You may change the start-up type of the service routine to Manual if you do not want the program to automatically launch at boot time.

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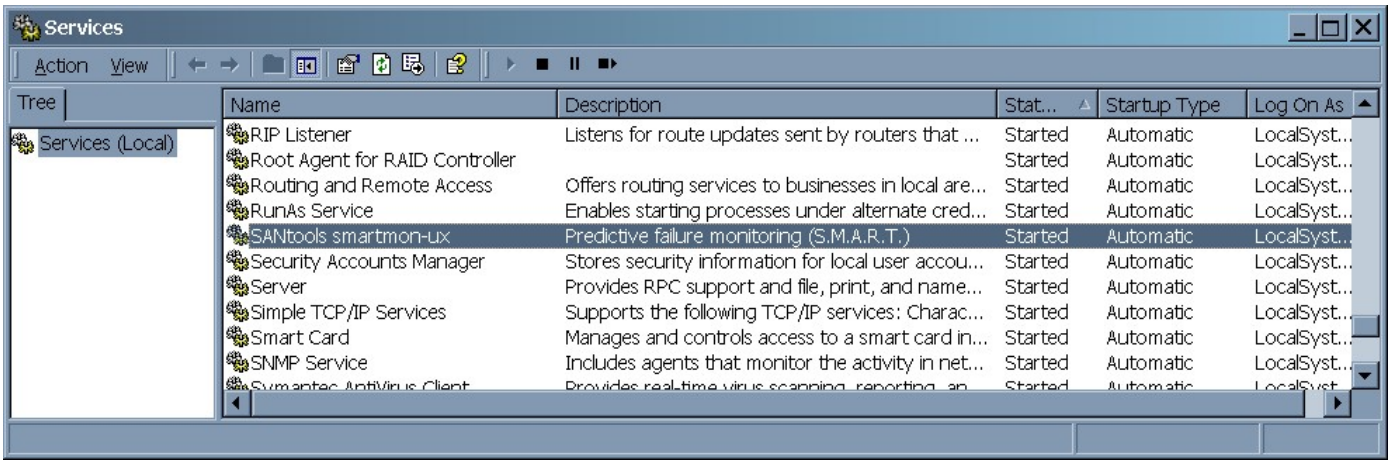
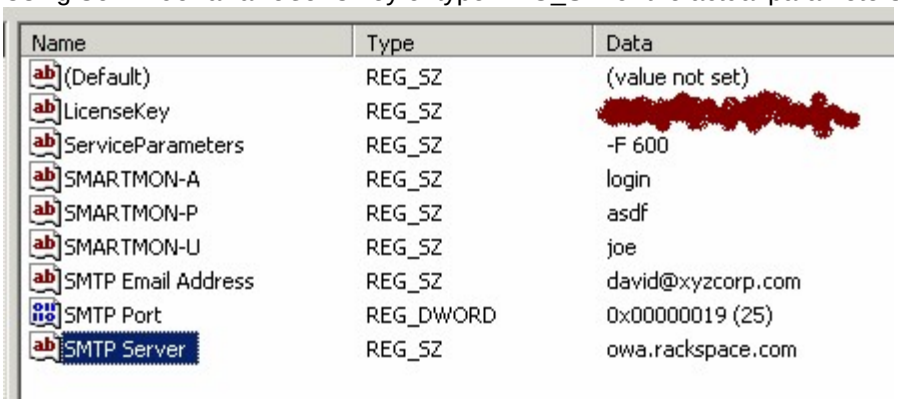


Note: Significant logic changes were made in order to insure the program works under Vista and Windows 2008.

Registry entries for the service are saved in:
`My Computer\HKEY_LOCAL_MACHINE\SOFTWARE\SANtools\SMARTMonUX`

Using `ServiceParameters` key of type REG_SZ for the actual parameters.



1.5 Invoking & Command-Line Options

SMARTMon-UX may be invoked as follows:
smartmon-ux
smartmon-ux [options] **[device_list]** 22
smartmon-ux -h

(If you are on an Apple, you must either run from root or invoke the software with sudo, as in **sudo ./smartmon-ux** **[options]** 17 **[device_list]** 22)

If you launch smartmon-ux without any options, the program will discover and report all devices, enable S.M.A.R.T. on all drives that support this feature, set the polling interval to 10 minutes, and run in the background. Status messages be recorded in the system log file, unless overridden by using the **-L** option as described below. All command details are below, listed in alphabetical order.

With only a few exceptions, all operating systems support all of these commands. The most notable exception is that Windows platforms do not support the -O command, and that the -16 22 or -12 22 command may require a service pack, kernel patch, or update.

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***Case-sensitive* options (grouped alphabetically). *Some commands, such as the -Mail 8 function are specific to certain operating systems*.:**

-A 79 — Displays a hex dump of all mode pages for all devices (or devices in device list) and terminates the program.

-B C|S Hlist 79 — Invokes the mode page editor feature to program revised mode page data for the selected disk(s). The **-C** flag is used to tell the program to change the current settings, and the **-S** flag instructs it to change the saved, or permanent settings. The saved settings will make the new mode page non-volatile, so they will be in force when the disk goes through a power cycle. The current mode page setting will be effective immediately and will be lost when the disk recycles. Never change the S page unless you are 100% sure you know what you are doing, as you could render your disk drive invisible to the operating system, or even cause data loss.

The Hlist is the hexadecimal list of bytes that you want programmed into the disk. The program checks for valid syntax and byte count, but it does not protect you against programming the disk drive with settings which may be inappropriate for your particular environment.

Example **smartmon-ux -B C 1A,A,0,1,0,0,0,0,0,0,8c,a0 /dev/sga** would instruct the selected disk to automatically spin down after 60 minutes of inactivity.

-bmsd 217 — Disables background media scanning (Available on certain Seagate disk drives)

-bmse n 217 — Enables background media scanning, and sets interval to n hours

-bmsr 217 — Reports background media scanning state and provides detailed report

-capacity n 28 — Reprograms / resizes the disk programmatically, so that it reports a user-defined capacity of n blocks. Send **`-capacity 0`** to reset the disk to maximum capacity.

-capacitybs n 28 — Sets the block size of the device to n bytes.

-confirm — Automatically responds "Y" to the are-you-sure type messages you get before running potentially destructive functions.

-C 65 — Dump statistical device information (Log pages - in decoded ASCII text) *see notes below*

-Cx 66 — Dump statistical device information (Log pages - in decoded ASCII text). This is an improved syntax that suppresses a trailing field that indicates the number of bytes that the peripheral allocates to the field.

-C+ 68 — Same as the -C, only do brute-force log page discovery. Use this to force the program to manually poll every possible log page. Use this for devices which have log pages that are not reported due to the device not meeting ANSI compliance.

-d — Specifies that the remainder of the command-line contains a device list and/or device wild-card expressions

-E 37 — Poll SES/SAF-TE information (fans, power supply, enclosure temperature), etc. This requires your disks to be mounted in either a SES-compliant enclosure, or SAF-TE enclosure.

-E+ 37 — This is the verbose mode of the SES query. It displays additional details on many models of enclosures that are vendor-specific extensions to the ANSI SES specification. If you are addressing a SAF-TE enclosure, no additional information will be displayed.

-EF 37 — Add this command to any -E family command to address situations where no SES data is reported, but you *know* the enclosure supports SES. This instructs the program to perform a brute-force SES discovery rather than query the enclosure's capability. As some enclosures and enclosure firmware are not fully ANSI compliant, we were forced to add this command to address the situation.

-EH 37 — Print hex dump of all enclosure pages (includes both ANSI defined and vendor-specific pages)

The "EP" functions allow you to program characteristics of your SES-enabled enclosure. Not all SES enclosures support all of these commands. Further details on these commands can be found in the section Enclosure Services Configurator 36.

-EPAMn 37 — Mute audible alarm #n

-EPAmn 37 — Un-mute (turn on) audible alarm #n

-EPARn 37 — Set alarm #n to reminder mode

-EPArn 37 — Clear alarm #n from reminder mode

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-EPATxn 37 Set alarm tone urgency control for alarm #n to x, where x is hex value 0 - F
-EPDFn 37 Enable visual fault indicator for device in slot #n
-EPDfn 37 Disable visual fault indicator for device in slot #n
-EPDIn 37 Identifies device in Slot #n
-EPDin 37 Disable identification for device in Slot #n
-EPLFn 37 Enable visual fault indicator for array device in slot #n
-EPLfn 37 Disable visual fault indicator for array device in slot #n
-EPLIn 37 Identifies array device in Slot #n
-EPLin 37 Disable identification for array device in Slot #n
-EPLRn 37 Enable visual rebuild indicator for array device in slot #n
-EPLrn 37 Disable visual rebuild indicator for array device in slot #n
-EPLSn 37 Enable visual remove indicator for array device in slot #n
-EPLsn 37 Disable visual remove indicator for array device in slot #n
-EP2ttnnwwxxyy 34 Provides complete programmability of all SES control page fields, whether ANSI defined or vendor-unique. This sends bytes **`ww xx yy`** to SES control page 2, for element type **`tt`**, element number **nn**. The section Enclosure Services Reprogramming 34 contains further information. All command options must be 2-character hex numbers.
-F freq Sets the default polling frequency from 600 seconds (10 minutes) to any number of seconds. (This option can now be added in combination with dump-type options such as -I+ 54 to cause program to wait until exiting. You would ordinarily need this under Windows only, if you were using a .BAT script). *Setting the freq 18 value to 0 instructs the program to poll once and then exit.*
-fc 128 Dumps additional fibre channel information (SAN discovery, frame-level statistics and errors, fabric and switch information, etc...)
-fchbainfo 142 Report Fibre Channel HBA information (make, model, firmware, driver, etc...) and exit.
-fciostat 143 **[options ...] [<interval>] [<count>]** Equivalent of UNIX **`iostat`** function, but for fibre channel HBAs.
-fciostat 143 **[-help | -?]** Reports option and usage info specific to this function
-fcping 140 **WWN LUN [n]** Pings a fibre channel port WWN and LUN, n times. This will verify connectivity as well as report return time in thousandths of a second. (If n=0, then ping indefinitely)
-flash FILE 47 Flash new firmware image saved in FILE.
-flashses 49 Flash firmware to SES-compatible enclosure
-flashses7 49 Flash firmware to SES-compatible enclosure (uses alternate "mode 7" technique, in event the enclosure does not support **`-flashses`** command)
-format 50 Format disk (perform a low-level format / i.e., issue FORMAT UNIT command) to the selected SAS/SCSI/FC/USB disk.
-formatb 52 Format disk (perform a low-level format / i.e., issue FORMAT UNIT command) to the selected SAS/SCSI/FC/USB disk in background (most disks support this, the program will not lock up and wait until the formatting has completed until it returns.
-formatconf 50 Disables the safety are-you-sure message when accompanied by a **`-format`** family command.
-formatg 50 Same as the -format command, but this will instruct software to automatically clear the grown defect list. You would generally accompany this with the -formatconf 50 command to automate formatting within a script or batch file.
-G temp 157 Sets the thermal temperature warning in degrees Centigrade. If not specified, the default is 45 degrees.
-h Displays all of the above usage information, and terminates the program. (Many UNIX shells will substitute the ? character, so best to use this instead of -? 22.
-H 67 Dump statistical device information (Log pages - full hex dump) *see notes below*
-H+ 67 Same as -H, above, but uses brute-force discovery of all log pages 0 - 3E. Added for devices that do not properly report log page 0.
-HEALTH 67 General disk / tape health report (short format). No other command-line options are required.
-HEALTHFULL 67 Extended General disk / tape health report.
-i 63 International localization. Use this flag as part of any command-line to instruct the software to display date/time fields in the format native to your particular country.
-I 57 Displays a hex dump of all inquiry information for all devices (or devices in device list) and terminates the program. If the selected device uses a SCSI or Fibre Channel interface, this is

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	the standard SCSI inquiry output. If the disk is an IDE disk, the resulting output is from the Identify Device command.
-I+ 54	This is the *verbose* mode of the inquiry command, and it instructs the program to also display hex dumps of all *Extended Vital Product Data Pages* (EVPD pages. These extended pages display additional information such as serial numbers and vendor-unique information.
-IS	Returns the serial number of installed media for tape drives. This command is not supported by all tape drives.
-J 80	Mode page viewer - Decodes ANSI-standard mode pages settings and displays in readable text with descriptions
-K 158	Set to interactive mode to configure statistical/threshold monitoring 158 parameters
-L	Instructs program to send logger output to **`/var/log/smartmon-ux`**, or **`/var/adm/smartmon-ux`** depending on what O/S you are running. *(OS X and LINUX default to* **`/var/log`***, UNIXWARE, IRIX, SOLARIS, AIX, and HPUX go to* **`/var/adm`***).*VMS uses a log file SMARTMON.LOG in the currently selected directory. *Syslog, file, and windows event logging are discussed in more detail in the System Event Log 247 chapter.*
-LRemote Host 248	Sends messages to the remote system event log. (This flag only supported in Windows). Example **`-LRemote \\NOCSUPPORT2`**.or **`-LRemote \\12.18.1.25`**
-LB <Scriptfile>	Launches the program or script, **`<Scriptfile>`**, in event of a predictive failure alert or in conjunction with the test message (-T option)
-link 63	Reports current interface speed (U320, U160, U80 ...) of SCSI / FC device at polling time. Not all devices have this capability. Use this for enclosure and cable testing.
-Mail 8	Interactively configures email account settings for SMTP servers 8 that require authentication (Windows-specific flag).
-M <EMAIL>	Instructs program to send an alert via email to the email address supplied. Example: **`smartmon-ux -M david@xyz.com`**. The *sendmail (or other mailer) daemon* must be properly configured for your machine in order for this to work. Of course, the email address could also be that of a paging service or an alias list which would send the message to as many people as you desire. If you are running windows, you must configure the SMTP mail server 8. If you are using the Windows version, you must format the line as follows and use the **-N** option to supply the IP name of your email server. In addition, you can add up to 8 email addresses. If you do not supply either the **-N** or **-M** options, you will get a command-line error. Use the -Mail 10 command to define your email server. **smartmon-ux -N mail.gte.net -M "<sysadmin@gte.net>,"<mypager@gte.net>"** ... {This command is not supported under VMS}
-mpexport FILE 95	Exports all mode pages for selected device to an ASCII text file that you may edit. Use the **-mpimport** 98 command to burn the saved mode pages onto the same or equivalent device. (Example: **`-mpexport seagate.txt /dev/rdsk/c0d0s0`**)
-mpimport FILE 98	Imports mode pages from FILE and burns them onto selected device. Example: **`-mpimport seagate.txt /dev/rdsk/c0d0s0 /dev/rdsk/c0d[3-5]s0`**
-N SMTPAcct	This windows-specific flags let you assign the desired EMAIL server for sending messages. The SMTPAccount must be the full network name, rather than an IP number. See the example above 19.
-O 74	Dumps detailed ATA/SATA disk drive error log report on supported operating systems.
-P	Enable the performance (PERF) bit. This disables S.M.A.R.T. tests which could cause delays. Not all disk drives support this feature.
-p 78	Disable S.M.A.R.T. for selected disks and exit. The disks are programmed via the mode page editor to turn feature off in current (volatile) settings. The saved (non-volatile) pages are not affected. You must use the mode page editor 79 feature to permanently disable S.M.A.R.T.
-pp 78	Disable S.M.A.R.T. for selected disks, and save it, so that the only way to revert is use the mode page editor.
-ping 102	Report if device has been removed or does not respond to a poll (after initial discovery).
-Q	Displays partition information 99 and file system types, then the program is terminated. (This option is available on the LINUX, SPARC, OS X and Windows™ family operating systems).
-random n	Sets every bit on the selected SAS, SCSI, USB or fibre channel disk to random data. Then **-**

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n refers to the number of desired passes. This does not use the secure erase function, but it is rather fast.

-rb BlockNo 104 Reassign block #BlockNo on selected SCSI, FC, SSA, or SAS disk. This feature is not yet supported on ATA or SATA devices. The Block number must be decimal).

-rb BlockNoh 104 Reassign block #BlockNo, but BlockNo is in hex, i.e. -rb f7d01h

-rc BlockNo 31 Corrupt block #BlockNo on selected SCSI, FC, SSA or SAS disk. The ECC information will be incorrect so the next read on that block will generate an unrecovered read error.

-read s,n,FILE 103 Reads n blocks from random access device starting at block #s and saves to binary file. (Block size can be from 512 - 528)

-S 72 IDE S.M.A.R.T. threshold and attribute pages 72 are displayed, then the program is terminated. (This option is only available on the LINUX, Apple OSX 10.3+, Solaris, and Windows™ family operating systems).

-scrub 120 Fitness test (full I/O test with detailed error reporting - usually takes hours

-scrubdi (options) 123 Destructive data integrity test.

-scrubdiv (options) 123 Destructive data integrity test - verbose.

-scrubv 121 Fitness test, same as above but verbose. Reports errors as discovered and percent complete.

-scrubq 120 Quick fitness test. Reads 32 blocks at a time for faster completion, but sacrifices granularity.

-scrubs 121 Sequential seek fitness test.

-scrubr 120 Pseudo-random seek fitness test.

-scrubt 121 Instructs program to terminate any "scrub" family fitness test upon first error with return code 11.

-secure n 112 Destroys all data on the disk by sending n triple-pass iterations of all zeros, ones, and random bits.

-securecheck n 111 Analyze data on device to confirm randomness and/or erasure patterns. The -n parameter sets the maximum time in minutes you want it to run. Enter 0 to check entire disk, or use -securecheckall.

-securecheckall 111 This analyzes the entire disk to validate and report randomness.

-sping 127 Report whether drive is spun up, down, or in a transitional state.

-spindown 127 Spin the drive down (same as SCSI STOP UNIT command) and wait for drive to spin down before returning.

-spindowni 127 Spin the drive down (same as SCSI STOP UNIT command) and return immediately after issuing command.

-spinup 127 Spin the drive up (same as SCSI START UNIT command) and wait for drive to spin up before returning.

-spinupi 127 Spin the drive up (same as SCSI START UNIT command) and return immediately after issuing command.

-steb 105 Initiates self-test 105, extended, background for selected SCSI, SAS, and fibre channel devices.

-steba 105 ATA/SATA Extended Background Self-Test. Note: This will typically take 1-2 hours, but it does not lock up the disk.

-stfd 108 Initiates factory default self-test. (Which is vendor/product specific, but generally completes in one or two minutes).

-stefa ATA/SATA Extended Foreground Self-Test. Note: This will lock up the drive while it runs, do not perform it on a disk that is mounted by the O/S.

-stsb 105 Initiates self-test 105, short, background for selected SCSI, SAS, and fibre channel devices.

-stsba ATA/SATA Short Self-Test. (Must complete in under 2 minutes per ANSI specification)

-sta 105 Aborts current self-test 105 for selected SCSI, SAS, and fibre channel devices

-staa Aborts current self-test for selected ATA / SATA disk device.

-str 105 Reports results and status of current and last self-tests 105 for selected SCSI, SAS, and fibre channel devices.

-stra 105 Reports results and status of current and last self-tests 105 for selected SCSI, SAS, and fibre channel devices.

-T <EMAIL> Instructs program to send out a test predictive failure alert. The <EMAIL> address is optional. This may be used with the **-LB** 19 option.
(Windows users will normally add the -N flag and SMTP server name to specify an account to

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use).

-sq Suppress logging successful polling messages in the system event log.

-sqq Suppress all logging into the system event log.

-wsbyte hexbytevalue 125 Writes the hex byte value to every block on the selected device using the efficient WRITE SAME command.

-wsbyteconfirm hexbytevalue 125 Writes the hex byte value to every block on the selected device using the efficient WRITE SAME command. The -wsbyteconfirm command does not ask an are-you-sure question, so it can easily be scripted.

-wsc 125 This optional command can be used with both **`-wsbyte`** and **`-wsbyteconfirm`**, and it instructs the program to immediately terminate after a write error on the disk drive.

-V Displays version number information 166 and exits program.

-V+ 166 This displays all of the vendor-specific statistical fields 65 the program is aware of.

-verify 165 Instructs disks to read/verify all sectors on the device. Bad blocks will be reported. (This runs mostly within the disk firmware so it is very fast). The command is supported under all SAS/FC/SCSI disks as well as SATA/ATA disks under windows only.

-Wfilename Enables threshold monitoring 158, using parameters defined in filename. Combine this command with the -F option and a list of desired SCSI/FC devices. The configuration file, **filename** created interactively with the -K 158 command. Example: -F 60 -WUnrecoveredWriteDaemon.cfg

Important: there must NOT be any white space between the -W and the filename. (If you leave white space, then the program will incorrectly interpret the next option as a physical device name)

-wcd 196 Disable write cache. This disables a SCSI/SAS/SSA or Fibre channel disk drive's write cache. (The function is currently not supported on IDE or SATA disks).

-wce 196 Enable write cache. This enables a SCSI/SAS/SSA or Fibre channel disk drive's write cache. (The function is currently not supported on IDE or SATA disks).

-wp 197 Write-protect test. This performs a test to see if media (typically tape) is write protected.

-X 148 Polls selected tape devices that support the TapeAlert 148 feature. (This can be equated to S.M.A.R.T. for disk drives).

-XT 146 TapeAlert Test. This enables test mode, does single poll, disables test mode, then exits. It should not be run on tapes/auto changers currently in use.

-X+ 150 Reports all TapeAlert components that the selected tapes are capable of reporting. Note: Not all tape drives can be queried to learn exactly what TapeAlert flags it supports. Program terminates after displaying this information.

-Y Dumps factory and grown defect lists 32 for selected disk devices.

-z 201 Report physical and logical drive information for selected IBM, SGI and Engenio (formerly LSI) RAID engines.

-Z 198 Report physical and logical drive status for subsystems using Mylex fibre channel external RAID engines. Supported engines are FF, FFX, FF2, FFx2, also known as the SANArray Pro family. All engines must be running FW 7.0 or higher. [Mylex RAID]

-ZA start# n 201 Display n RAID event log entries >= starting# (if n=0, display all events) [Mylex RAID] Example: **`smartmon-ux -ZA 3440 32 /dev/sgj`** would dump up to 32 events starting at event #3440

-ZL 199 Display all RAID event log entries. [Mylex RAID]. This option may be run without the -Z flag).

-ZM Report Mylex SAN-Mapping table

-zd[x] 213 Report physical and logical drive info for selected LSI-MPT family RAID engines. The -x suffice reports extended information.

-zdL 215 Report LSI-MPT RAID event log

-zdq 213 Report LSI-MPT physical disk status and serial numbers

-zi 208 Report physical and logical drive information for Infortrend-family RAID engines.

-zie 209 Display enclosure state summary and full event log [Infortrend RAID].

-ziL 209 Display all RAID event log entries [Infortrend RAID].

-zm 210 Continuously monitor Infortrend event log rather than just dump and exit.

-zix 210 Report detailed back-end drive information [Infortrend RAID]. This should be run during a maintenance window.

-ziA start# n 210 Display n RAID event log entries >= starting# (if n=0, display all events) [Infortrend RAID]

-z3[x] 210 Report physical and logical drive info for selected 3ware (AMCC) family RAID engines. The

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optional "x" suffix reports extended information.

-z3d 212 Report controller (3ware (AMCC)) diagnostic dump (this is very cryptic but useful to RAID controller experts and OEMs who imbed the controller

-z3L 213 Report controller (3ware (AMCC)) event log

-z3m 213 Monitor 3ware / AMCC health in background (or as a Windows service)

-? Displays all of the above usage information and terminates the program. (Many UNIX shells will substitute the ? character, so best to use the -h 18 flag instead.

-16 Forces the **-ws**, **-wsbyte**, and all "**scrub**" family commands to send READ(16) and WRITE (16) CDBs instead of 10-byte CDBs. Note that your O/S, drivers, and target peripheral must all support these extended SCSI commands. (Windows uses need Win2003 with SP1, and LINUX users will require the 2.6 kernel).

-12 Forces the "**scrub**" family commands to use the READ(12) and WRITE(12) commands instead of the READ(10) and WRITE(10) CDBs.

Unless the debug parameter is sent, the program will run in the background. This has the same effect as entering a trailing ampersand (&). i.e., **smartmon-ux -F 3000** has the same effect as **`smartmon-ux -F 3000 &`**. This is by design, to automate running SMARTMon-UX at boot time 31.

Some examples:

1) **smartmon-ux** — Scan for all disk drives. If any disk drives that support S.M.A.R.T. are **found, then the program re-launches itself in the** background with a 10-minute polling period, and sends the results to the system log file

2) **smartmon-ux -M admin@xyz.com** — Same as above, but alerts are sent to email address supplied.

3) **smartmon-ux -I -S /dev/sd0 /dev/sd3** — Dumps inquiry data and mode pages for the two disks, /dev/sd0 and /dev/sd3 and terminates the program.

Notes on Statistical Device Information

The statistical information options (**`-C`** & **`-H`**) are applicable to SCSI, Fibre Channel, and IBM SSA disk drives only. IDE disks do not maintain these fields. Most of the data is non-volatile, and they are stored in what is called Log Pages. Some fields are defined by the ANSI SCSI specifications, and others are vendor/drive specific. There is a lot to discuss here, so we have dedicated a chapter called Log Page Viewer 65 to this subject.

Notes on Device List and using Wild Cards

The **[device_list]** is used to supply a list of physical devices which you want the command-line options to be executed on. If you do not supply a device list, all devices will be acted upon. So, if you were to enter **smartmon-ux -I**, it will display inquiry information for all devices it discovers.

By using wild cards, you can quickly enter multiple devices rather then entering them individually. The ***** matches any string of characters or numbers, any length from that point onward. The **[list]** matches any single character in the list. i.e, /dev/rdsk/c[236]d* means it will match /dev/rdsk/c2d*, /dev/rdsk/c3d*, or /dev/rdsk/c6d*.

You may also combine devices that use wild cards, and those that do not, as in "**./smartmon-ux /dev/sga /dev/sgc /dev/rmt/***".

Apple users will use device numbers, as in **./smartmon-ux 0 3 8**

Commands by Function Type

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Flag	Description	Destructive	Notes
Polling Commands (Program continues to run if only these commands are supplied)			
-E	Enclosure check	No	This command can be run in foreground also
-F	Polling frequency	No	Default if **-F** not supplied is 10 minutes
-G	Thermal warning	No	Adds temperature to polling log if supported on device.
-i	International date/time	No	Returns date/time in local language & format
-link	SCSI/FC link speed	No	Adds current interface speed to poll
-L	Logging	No	Sends messages to smartmon-ux file instead of syslog
-LRemote	Logging	No	Specifies remote host (For Windows version, Active Directory implementations)
-sq	Logging	No	Suppress logging successful polling messages. (Only messages that indicate a problem will be logged).
-M	E-Mail address	No	SMART Alerts, Tape Alerts and threshold warnings generate email.
-P	PERFormance bit	No	SCSI/FC drives prioritize application I/O over S.M.A.R.T. tests
-Wfilename	Statistical alerting	No	Combine with the **-F** to set minimum time between polls and to issue custom threshold monitoring scripts using config file supplied with **-W** (replace filename with the name of your file, as in **-F 60 -WUnrecoveredWriteDaemon.cfg** [You must not have a space between the **-W** and the file name)
-X	TapeAlert monitoring	No	Like S.M.A.R.T., but for tape drives and auto changers.

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General reporting commands (Program terminates after reporting information on first pass)			
Flag	**Description**	**Destructive**	**Notes**
-A	Mode page hex dump	No	
-J	Mode page text dump	No	
-C	Log page text dump	No	
-Cx	Log page text dump	No	You will most likely prefer output of **-Cx** over **-C** as this suppresses the trailing [x] on each field that reports the field size. As a large part of our customers have scripted commands to parse the output, we chose to implement the improved results with **-Cx** rather than break any scripts by modifying the syntax of **-C**
-H **-H+**	Log page hex dump	No	The **-H+** provides same output as the **-H**, but the **-H+** does a brute force discovery. This is necessary because some peripherals are not fully ANSI compliant in that they do not provide a list of log pages. As such the **-H** attempts to read every possible log page. This results in a large amount of I/Os that are likely unnecessary. You would only use the **-H+** command if the **-H** command doesn't report any log pages.
-E	Enclosure status	No	
-E+	Extended enclosure status	No	**-EF** and **-EH** are related commands.
-I	SCSI Inquiry dump	No	
-I+	Extended SCSI inquiry	No	
-IS	Return serial number	No	Returns serial number of removable media. (Generally for auto changers and tape libraries).
-O	IDE (ATA/SATA) inquiry	Possibly	The **-O** option could take several seconds to complete, so this might be disruptive. We have seen this command take almost 30 seconds on disks that have problems.
-Q	Disk/CD partition dump	No	
-S	IDE, SATA, ATA S.M.A.R.T. dump	No	
-V	Display version level	No	
-V+	Display vendor-unique log/ inquiry details	No	(This is a rather long report that shows all reportable vendor unique device information)
-X+	TapeAlert capability	No	
-XT	TapeAlert test	No	Temporarily enables Test function which is not supported on all tape changers/drives.
-Y	Factory/Grown defects	No	

SES Enclosure commands (Applicable to SES-compliant FC-attached enclosures only)			
Flag	**Description**	**Destructive**	**Notes**
-EPDF	Fault light on	No	
-EPDf	Fault light off	No	
-EPDI	Identity light on	No	
-EPDi	Identity light off	No	
-EPAM	Mute alarm	No	
-EPARm	Clear alarm	No	
-EPArn	Set alarm to reminder	No	
-EPAT	Clear alarm reminder	No	
-EPLFn	Fault light on, for array device	No	Some enclosures classify individual drive slots as Array Slots. If the LED does not light with the **-EPDF** command, try this instead. This is the same for the identify LED (**-EPDI**)
-EPLfn	Fault light off, for array device	No	
-EPLIn	Identity light on, for array	No	

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	device		
-EPLin	Identity light off, for array device	No	
-EPLRn	Array device rebuild indicator on	No	
-EPLrn	Array device rebuild indicator off	No	
-EPLSn	Array device remove indicator on	No	
-EPLsn	Array device remove indicator off	No	
-EP2	User defined SES	Possibly	May be destructive, if your enclosure lets you send commands to turn off all fans, or example.

Mode Page Programming (Applicable to SCSI / FC / SAS / USB devices)

Flag	Description	Destructive	Notes
-B	Single line editor	Possibly	In general, misconfiguring mode pages can render device invisible to O/S
-wcd	Disable write cache	No	
-wce	Enable write cache	Possibly	You should have the device on a UPS or you risk data loss if power is lost before the disk flushes pending I/Os in the cache.
-mpexport	Export mode pages to file	No	
-mpimport	Import mode pages from file	Possibly	Very convenient for cloning all mode pages for multiple devices.

Background Media Scanning (Applicable to SCSI / FC / SAS devices that support BGMS function)

Flag	Description	Destructive	Notes
-bmsd	Disable background media scanning	No	
-bmse n	Enable automated background media scanning every n hours	No	We strongly recommend you enable this feature.
-bmsr	Report background media scanning status and bad block list	No	The report will complete in a few seconds or less.

Secure Erase Family Commands

Flag	Description	Destructive	Notes
-secure n	Destroys all data on the disk	Yes	Set n to 1 for one iteration. This is normally sufficient. The official Department of Defense specification states that you must use 3 full passes for compliance to their spec.
-securecheck n	Check to see if disk has "data" on it	No	The -n parameter sets the maximum time in minutes you want it to run. You will generally set the n value to 1, unless the disk is partitioned. If that is the case, set n to zero so it will test entire disk.
-securecheckall	Look for data on entire disk	No	This produces chart of how many times each byte is used on the disk, and whether or not there are any repeating patterns that could indicate there is live data.

Spin up, down, query (Also referred to START / STOP UNIT)

Flag	Description	Destructive	Notes

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-spinq	Inquire spin status	No	Set n to 1 for one iteration. This is normally sufficient. The official Department of Defense specification states that you must use 3 full passes for compliance to their spec.
-spindown	Check to see if disk has "data" on it	Possibly	Never spin a disk down a mounted disk with live data, unless it is your intention to simulate a drive failure. The software does not test to see if the disk is used in any way.
-spinup	Spin disk up and wait for confirmation	No	
-spindowni	Spin disk down (immediate)	Possibly	Same warning as stated above about spinning mounted disks down
-spinupi	Spin disk up (immediate)	No	The immediate bit, as defined by ANSI, basically means to return an OK status immediately after the command has been sent, rather than pausing the program while waiting for disk to start up.

Miscellaneous Programming

Flag	Description	Destructive	Notes
-capacitynBlocks	Changes drive capacity (resizes disk)	No	Not destructive as it is reversible, but it can hide usable storage
-capacitybs Blocksize	Changes block size	Yes	All data will be lost and drive must be reformatted. Block sizes are normally 512, but some RAID systems, such as NetApp and EMC use 520 block sizes
-confirm	Automatic affirmative response	No	Responds "Y" to any are-you-sure type messages that are typically associated with destructive commands such as running a destructive write data integrity test.
-flash	Flashes device firmware	Possibly	If you use wrong firmware image then device may have to go back to factory to get recovered.
-format	Low level format	Yes	All data will be lost (unless the data was all zeros)
-p	Disable S.M.A.R.T.	No	S.M.A.R.T. setting will revert to previous value after power cycle
-pp	Disable S.M.A.R.T. , permanently	No	This turns off S.M.A.R.T. so it stays off after power cycle. You must enable it with the mode page editor 95 function.
-rb	Reassign block	Possibly	
-rc	Corrupt block	Yes	Destroys contents of this block by corrupting ECC data. Use this to test to see that a corrupted block is handled properly by your RAID engine or path/data fail over redundancy hardware or software.
-wsbyte	Write SAME	Yes	Sends same byte to every block on the random-access device
-wsbyteconfirm	Write SAME	Yes	Same as **-wsbyte**, but no are-you-sure
-16	16-byte CDB	Possibly	This forces program to use the 16-byte SCSI command instead of the 10-byte SCSI commands for the **-ws** and **-scrub** family functions. Your host O/S and drivers, and target devices must all support 16-byte commands.
-12	12-byte CDB	Possibly	This forces using the READ(12) and WRITE(12) commands for the -scrub family commands. Like the 16-byte commands, it is not necessarily going to be supported by your O/S or your storage hardware.

RAID Engine Reporting Commands

Flag(s)	Description	Destructive	Notes
-z	Physical drive status (LSI	No	Command ignored if an unsupported RAID engine

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	& Mylex engines)		
-Z	Physical & logical drive status (Mylex engines)	No	If you know you have a Mylex (external RAID) engine, then no need to combine with -Z
-ZL	Full Mylex event log	No	
-ZA	Selective Mylex event log	No	Same as -ZL, but you can start at a particular event number
-ZM	Report Mylex SAN-Mapping table	No	
-z3	Physical and logical drive status (3ware (AMCC) RAID engines)	No	Command will be rejected if it is sent to something other than a 3ware 7xxx, 8xxx, or 9xxx family controller.
-z3d	Reports 3ware (AMCC) diagnostic dump	No	
-z3L	Reports 3ware (AMCC) event log	No	
-zd, -zdx, -zdL	Reports Dell (LSI MPT family) RAID controller information	No	In general, all RAID commands will be rejected by the target device if they are sent to the wrong type of controller, or sent to something other than the RAID controller.
-zi	Physical and logical drive status (Infortrend RAID engines)	No	In general, all RAID commands will be rejected by the target device if they are sent to the wrong type of controller, or sent to something other than the RAID controller.
-zie, -zil -ziA, -ziL, -zm	Event-log related reporting commands.	No	The RAID controller will acknowledge that the event log has been reported, but SANTOOLS instructs the RAID engine to not delete them after they have been reported.
-zix	Detailed physical device information and controller data.	Possibly	You should not run this command if the system is actively processing I/Os. Some of the commands that it generates could cause a time-out which might affect your host O/S or an application.

Miscellaneous Commands

Flag	Description	Destructive	Notes
-LB	Specifies batch program to run in event of predictive failure	No	Run program with -T and -LB options to test proper launching of the batch program.
-read	Reads raw device info and saves into file	No	
-T	Test predictive failure system alerting.	No	If you pass an email address with this option, you must make sure that your host is configured to send email. Windows users can use the imbedded -Mail command to set up email settings, other operating systems require properly configured sendmail. You may also combine -T with -LB
-K	Interactive mode for configuring threshold monitoring	No	Program goes into interactive wizard mode to assist setting up threshold monitoring.
-Mail	Interactive command for configuring mail server settings	No	Windows specific option for configuring client PC to be able to send messages to the SMTP server (username, password, IP name, etc..)
-N	SMTP Server name	No	Windows specific option, combine with -T and/or -M

Service Management Commands

The Windows version of the program has several commands that deal with installing, starting, stoping, and controlling the program when it runs as a Windows service routine. See the Running as a Windows Service 14 chapter for additional details.

Command Syntax:

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You may use either **smartmon-ux -h** or **smartmon-ux -?** to get help and usage information. As many UNIX/ LINUX shells substitute the '?' character for a single-byte wild-card, you should just enter **smartmon-ux -h** for help, which will work for all operating systems and shells.

1.6 Change Block Size

Invoke the **-capacitybs** command to change the block size of your random access device.

Usage
```
smartmon-ux -capacitybs NewBytesPerBlock DeviceList
```

Example
```
smartmon-ux -capacitybs 520 /dev/sg3  (sets the block size to 520 bytes/block)
```

With few exceptions, disk drives are set to 512 bytes per block, and operating systems expect disks to be formatted to 512 bytes per block. In fact, some operating systems and/or disk controllers won't even "see" disks that aren't formatted to 512 bytes/block. This command exists because certain RAID controllers require disks to be formatted to 520 or 528 bytes/block. If the disk isn't formatted to the appropriate block size then it just won't work with the required hardware. Once this command has been accepted by the disk, and you invoke the **-format** 50 function to reformat the disk, then you should be able to use it.

Warnings & Caveats
Once the block size is successfully changed, you need to power cycle the disk drive and use the **-format** command to complete the operation. You can not use the disk drive until you reformat it.

RAID subsystem manufacturers have little motivation for allowing end-users to add their own disk drives. This isn't just for financial reasons, but for data integrity and reliability concerns. Furthermore, RAID subsystem manufacturers invest a significant amount of R&D in having customized drive firmware. As such, even if you take an off-the-shelf disk drive, and change the blocks size and all of the mode page settings to get it to match your RAID vendor's disk drive, then the RAID engine may still reject the disk.

SANtools is bound by numerous non-disclosure arrangements and we will not provide any advice relating to how one might reprogram or reformat a disk so you can get it to work in a specific RAID subsystem.

Let's say that you have the opposite problem. You purchased used disk drives and it turns out that you can't format them because they aren't formatted to 512 bytes/block. You still have risk that the firmware on those disk drives will reject commands to change the block size. It is not uncommon to have disk drives with specialized firmware that prevents you from changing the block size. If the disk rejects the **-capacitybs** command, then the only way to change the block size is to flash new firmware on the disk drive. (Not just new firmware, but the correct firmware file) As your disk drive firmware isn't our intellectual property, we are morally and legally prevented from sending anybody firmware.

The bottom line is that some disk/firmware combinations let you change the block size, and some don't. If your disk rejects the **-capacitybs** command, then you must call your drive supplier/vendor, and ask them about getting some firmware that will let you change the block size.

1.7 Change Disk Capacity

The **-capacity** command is used to resize the number of blocks that a disk reports. You would use it to short-stroke a disk (resize the disk to make it smaller). Once you resize the disk with the command, then you can use the resized disk immediately, and it does not need to be reformatted. This function can be quite useful, either to hide a partition on a disk, or to unlock space that was hidden by your hardware supplier.

You may reverse the effects of changing capacity by sending it a new size of 0. This will allocate all available disk space, and cause the disk to report the full factory-configured capacity.

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Usage

smartmon-ux -capacity NewBlockSize|0 DeviceList

Send 0 to reset **capacity** to factory default, or pass it a number of blocks that you wish capacity to be set to. (There are 2048 blocks in 1 MB, assuming a standard 512-byte block size).

Example

First, we instruct the computer to report the drive size to establish a base-line. The fields in **GREEN** are of most interest for this example.

```
D:\>smartmon-ux -I \\.\PHYSICALDRIVE10
SMARTMonUX [Release 1.30, Build  5-DEC-2005] - Copyright 2001-2005 SANtools, Inc. http://www.SANtools.com
Discovered SEAGATE ST3300007FC S/N "3KR0EYV4" on \\.\PHYSICALDRIVE10 [SES] (Not Enabling SMART) [Bus/Port/
ID.LUN=1/2/13.0](286102 MB)
 Inquiry Text Page Data - ANSI defined fields
   Device Type:                          disk
   Peripheral Qualifier:                 Connected to this LUN
   Removable Device:                     NO
   ANSI Version:                         3 (SPC ANSI X3.301:1997)
   Vendor Identification:                SEAGATE
   Product Identification:               ST3300007FC
   Firmware Revision:                    XR32
   Async event reporting: (AERC)         NO
   Terminate task supported:             NO
   Response data format:                 2
   Relative addressing supported:        NO
   Supports request/ACK data transfer:   NO
   Normal ACA Supported:                 NO
   Enclosure services available:         YES
   Multi-ported device:                  YES
   Medium-changer attached: (removable) NO
   Linked commands supported:            YES
   Command queuing supported:            YES
   VS bit (byte #6/bit #5 set):          YES
   VS bit (byte #7/bit #0 set):          NO
   Total Capacity (In Bytes):            300000000000
   Total grown defects:                  0
   Total Primary (factory) defects:      5246
  Inquiry Page Hex Dump:
   0000: 00 00 03 12 8B 00 70 0A 53 45 41 47 41 54 45 20    ......p.SEAGATE
   0010: 53 54 33 33 30 30 30 30 37 46 43 20 20 20 20 20    ST3300007FC
   0020: 58 52 33 32 33 4B 52 30 45 59 56 34 00 00 00 00    XR323KR0EYV4....
   0030: 00 00 00 00 00 00 00 00 0C 00 00 00 00 00 00 00    ................
   0040: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
   0050: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
   0060: 00 43 6F 70 79 72 69 67 68 74 20 28 63 29 20 32    .Copyright (c) 2
   0070: 30 30 35 20 53 65 61 67 61 74 65 20 41 6C 6C 20    005 Seagate All
   0080: 72 69 67 68 74 73 20 72 65 73 65 72 76 65 64       rights reserved

The Seagate disk reports as 300,000,000,000 bytes which corresponds to 2861024 MB.  We will now resize the
drive to exactly 204800 blocks which
is exactly 100 MB. The reported capacity on the "Discovered" line is the capacity that the disk reported
before resizing.

D:\>smartmon-ux -capacity 204800 \\.\PHYSICALDRIVE10
SMARTMonUX [Release 1.30, Build  5-DEC-2005] - Copyright 2001-2005 SANtools, Inc. http://www.SANtools.com
Discovered SEAGATE ST3300007FC S/N "3KR0EYV4" on \\.\PHYSICALDRIVE10 [SES] (Not Enabling SMART) [Bus/Port/
ID.LUN=1/2/13.0](286102 MB)
 Capacity is 204800 blocks (100 MB)

Now, we issue the standard inquiry command to see what the disk reports. Unless the -capacity command was
rejected by the disk, it will report the new size.

D:\>smartmon-ux -I \\.\PHYSICALDRIVE10
SMARTMonUX [Release 1.30, Build  5-DEC-2005] - Copyright 2001-2005 SANtools, Inc. http://www.SANtools.com
Discovered SEAGATE ST3300007FC S/N "3KR0EYV4" on \\.\PHYSICALDRIVE10 [SES] (Not Enabling SMART) [Bus/Port/
ID.LUN=1/2/13.0](10000 MB)
 Inquiry Text Page Data - ANSI defined fields
   Device Type:                          disk
```

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```
  Peripheral Qualifier:               Connected to this LUN
  Removable Device:                   NO
  ANSI Version:                       3 (SPC ANSI X3.301:1997)
  Vendor Identification:              SEAGATE
  Product Identification:             ST3300007FC
  Firmware Revision:                  XR32
  Async event reporting: (AERC)       NO
  Terminate task supported:           NO
  Response data format:               2
  Relative addressing supported:      NO
  Supports request/ACK data transfer: NO
  Normal ACA Supported:               NO
  Enclosure services available:       YES
  Multi-ported device:                YES
  Medium-changer attached: (removable) NO
  Linked commands supported:          YES
  Command queuing supported:          YES
  VS bit (byte #6/bit #5 set):        YES
  VS bit (byte #7/bit #0 set):        NO
  Total Capacity (In Bytes):          104857600
  Total grown defects:                0
  Total Primary (factory) defects:    5246
 Inquiry Page Hex Dump:
  0000: 00 00 03 12 8B 00 70 0A 53 45 41 47 41 54 45 20    ......p.SEAGATE
  0010: 53 54 33 33 30 30 30 30 37 46 43 20 20 20 20 20    ST3300007FC
  0020: 58 52 33 32 33 4B 52 30 45 59 56 34 00 00 00 00    XR323KR0EYV4....
  0030: 00 00 00 00 00 00 00 00 0C 00 00 00 00 00 00 00    ................
  0040: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  0050: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  0060: 00 43 6F 70 79 72 69 67 68 74 20 28 63 29 20 32    .Copyright (c) 2
  0070: 30 30 35 20 53 65 61 67 61 74 65 20 41 6C 6C 20    005 Seagate All
  0080: 72 69 67 68 74 73 20 72 65 73 65 72 76 65 64       rights reserved
```

We will now reset the disk by sending it a value of 0, which instructs the program to set the disk to the maximum capacity.

```
D:\>smartmon-ux -capacity 0 \\.\PHYSICALDRIVE10
SMARTMonUX [Release 1.30, Build  5-DEC-2005] - Copyright 2001-2005 SANtools, Inc. http://www.SANtools.com
Discovered SEAGATE ST3300007FC S/N "3KR0EYV4" on \\.\PHYSICALDRIVE10 [SES] (Not Enabling SMART) [Bus/Port/
ID.LUN=1/2/13.0](10000 MB)
 Capacity is 585937500 blocks (286102 MB)
```

The disk has been resized from 10000MB to the factory default of 286102MB.

Application Functional Notes

- Other vendors may have used this program or similar programs to resize disks, so if you believe your disk is reporting fewer blocks than it should, then use -capacity 0 option to resize the disk to the maximum capacity.
- This function is specific to SCSI, Fibre Channel, SAS, and SSA disks. We have not implemented this feature on other disks. (Interestingly, the command does work on some USB flash memory devices).
- Do not resize the disk if there is a file system on it, or any partitions that use any part of the older capacity that was deleted. If you do, then your operating system won't be able to access the hidden space, and this will likely corrupt the remaining file system.
- It doesn't matter what O/S version of our software you use to resize the disk, nor does it matter what operating system(s) the resized disk is used with. The changes are made to the disk, and not any O/S-specific drivers or configuration files.
- Blocks that have been removed via this command come from the end of the disk, so if you send smartmon-ux -capacity 2048, then the disk will report a size of 2048 blocks, ranging from block 0-2047. These blocks are not hidden or zeroed, the disk just thinks it is 2048 blocks in size and any program or utility or O/S that asks the disk how large it is will get an answer of 2048.

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1.8 Configuring for Automatic Start Up at Boot

If you are running a UNIX or LINUX operating system, the **configure** script invoked at installation will ask you if you want your O/S to automatically start the program when your computer enters the multi-user mode. It will prompt you for your desired settings, such as polling period and email address to send alerts to.

Windows-family users can utilize standard tools to invoke this program automatically at boot time by just configuring it in the startup folder with the appropriate options.

Notes for Apple users:

If you inform the installer that you want the program to launch at boot time, it makes the appropriate entries in the **`/Library/StartupItems/smartmon-ux`** directory. The program executable, however, will still be installed as **`/etc/smartmon-ux`**.

Notes for Windows users:

When the program is installed as a windows service (-serviceinstall 14), it will be configured to autolaunch at system boot time. You can change this parameter by launching the service control manager applet and configuring the software to run as a manual process. If you wish the service routine to manually launch after boot, use the service control applet (from control panel) to configure the program for manual startup.
See the Running as a Windows Service 14 section for full information.

We made significant modifications in version 1.35 so it runs as a service under Windows Vista, and Windows 2008, and so it automatically launches at power-up.

1.9 Corrupt Data Block

This function was introduced in release 1.28.

This function is generally used to corrupt ECC data on a particular block in order to test proper operation of data integrity checks, error logging, and mirroring/RAID hardware and software. Once you corrupt a block, the next read operation to that block will fail with an unrecovered read error (3/11). The block will stay corrupted until it is read or written to. When an application writes to that block, it will automatically be remapped by the disk drive and the error will be cleared.

Use this function to make sure your RAID hardware, host O/S, mirroring software, or diagnostic software reacts appropriately when you read from that block. You may also use this command to insure that the problem is picked up by self-test programs and operating system utilities. The block number must be a numeric number ranging from 0 to the last block number on the disk.

Syntax

```
smartmon-ux -rc BLOCKNUMBER devicename
```

where
BLOCKNUMBER is a decimal number for the block number.

Example

```
smartmon-ux -rc 12345678 /dev/sg3
```

Only one block can be corrupted at a time, but this is generally not an issue since one would typically only want to corrupt one or two blocks. The program will immediately execute and return. SANTOOLS uses both the **READ LONG** and **WRITE LONG** commands to determine the length of the ECC field for each block and to corrupt the data.

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1.10 Defect Reporting

When you invoke the **-Y** command, it instructs the software to report all primary (factory) and grown defects.\

The primary defect list (PLIST) is the list of defects that may be supplied by the original manufacturer of the device or medium. They are considered permanent defects. The PLIST is located inside a reserved area and is not accessible except through a low-level SCSI command, READ DEFECT DATA. Once the original PLIST is created at the factory, it is not subject to change.

The grown defect list (GLIST) includes all defects sent by the application client or detected by the device server. The GLIST does not include the PLIST. The GLIST shall include:

- Defects detected by the format operation during medium certification
- Defects previously identified with a REASSIGN BLOCKS command
- Defects previously detected by the device server and automatically reallocated

The grown defect list can be cleared by performing a special FORMAT UNIT command and providing it specific parameters to clear the list. We do not provide that capability because we can not see any real-world situation where one would want to clear the grown defect list. If we were to allow you to clear the defect list, eventually your operating system will attempt to put good data on blocks that were previously marked as bad and you would have data loss.

Below is sample output using the **-Y** command. Note that the device has no grown defects. This disk is reasonably new.

```
[root@rh90 smartmon]# ./smartmon-ux -Y /dev/sg0
SMARTMon-ux [Release 1.21, Build 26-JUL-2003] - Copyright 2003 SANtools, Inc. http://www.SANtools.com
Discovered SEAGATE ST373307LC S/N "3HZ0381E" on /dev/sg0 (Not Enabling SMART)(70007 MB)
   Total grown defects:                0
   Total Primary (factory) defects:    1749
    Head  Cylinder       Sector
    ----  --------   ----------
      2         49          885
      2         84           64
      2         85          172
      2         86          279
      2         86          280
... (trimmed response here)
      1      48047           31
      1      48048          475

Terminating program.
```

It is worth noting that not all disks support the low-level command to report either factory and or grown defects. If that is the case, smartmon-ux will continue without reporting such defects.

You should also know that disks can save defects in one of several formats. The defect list format is set at the time you (or the factory) issue the FORMAT UNIT command and clear the defect list. Smartmon-ux supports all ANSI-defined defect formats and will report them in the default format set at the time the device was initially formatted.

Note for LINUX users:

If you are not using the **/dev/sg** type drivers, you will probably not see a defect dump. As discussed earlier in this document, the standard /dev/sd class drivers are limited to 4KB commands. This is not sufficient to return a defect map, since it takes 8 bytes to report a defect. Adding overhead gives you room to report only 500 defects. This would seem like a lot, but it is not. Larger disks can have *thousands* of factory defects.

The output below is for the same disk, but the command did not use the sg class drive

```
[root@rh90 smartmon]# ./smartmon-ux -Y  /dev/sda
SMARTMon-ux [Release 1.21, Build 26-JUL-2003] - Copyright 2003 SANtools, Inc. http://www.SANtools.com
Discovered SEAGATE ST373307LC S/N "3HZ0381E" on /dev/sda (Not Enabling SMART)(70007 MB)
   Total grown defects:                0
```

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```
   Total Primary (factory) defects:     1749

Terminating program.
```

1.11 Enclosure Services Viewer (SAF-TE)

SAF-TE enclosures are the equivalent of SES enclosures, but for SCSI-attached hosts. Unlike SES enclosures, SAF-TE enclosures have a unique SCSI ID and LUN associated with them. The internal mechanism and commands that SMARTMon has to use to determine the health of a SAF-TE enclosure are different from those commands used to communicate with a SES enclosure. The net result is the same, however.

SAF-TE is the name for a specialized command set that is used to manage and sense the state of the power supplies, cooling devices, displays, indicators, individual drives, and other non-SCSI elements installed in a SCSI enclosure. If you have a SAF-TE-compliant enclosure, this software can decode and report this information.

Unless you have a very inexpensive enclosure, chances are good that your enclosure is SAF-TE-compliant. If you are not sure, invoke the **-E+** option and find out. Below is sample output from one of our enclosures when we unplugged one of the power supplies and ran the program on a Windows XP machine.

```
smartmon-ux -I+ -E+ \\.\SCSI3:
SMARTMon-ux [Release 1.13, Build 4-SEP-2002] - Copyright 2002 SANtools, Inc. http://www.SANtools.com
Discovered CNSi JSS122 S/N " " on \\.\SCSI3: (processor) [SAF-TE] [Adapter/ID.LUN=0/0.6]
 Inquiry Text Page Data - ANSI defined fields
   Device Type:                         processor
   Peripheral Qualifier:                Connected to this LUN
   Removable Device:                    NO
   ANSI Version:                        3 (SPC ANSI X3.301:1997)
   ISO/IEC Version:                     0
   ECMA Version:                        0
   Vendor Identification:               CNSi
   Product Identification:              JSS122
   Firmware Revision:                   L421
   Async event reporting:               NO
   Supports 16-bit wide addresses:      NO
   Supports 32-bit wide addresses:      NO
   Supports CONTINUE_TASK & TARGET XFR: NO
   Terminate task supported:            NO
   Response data format:                2
   Relative addressing supported:       NO
   Supports request/ACK data transfer:  NO
   32-bit parallel supported:           NO
   Normal ACA Supported:                NO
   Enclosure services available:        NO
   Multi-ported device:                 NO
   Medium-changer attached:             NO
   16-bit parallel supported:           YES
   Synchronous commands supported:      YES
   Linked commands supported:           NO
   Command queuing supported:           YES
  Inquiry Page Hex Dump:
   0000: 03 00 03 02 9B 00 00 32 43 4E 53 69 20 20 20 20    .......2CNSi
   0010: 4A 53 53 31 32 32 20 20 20 20 20 20 20 20 20 20    JSS122
   0020: 4C 34 32 31 30 20 20 20 20 20 20 20 53 41 46 2D    L4210       SAF-
   0030: 54 45 31 2E 30 30 00 00 0C 00 00 00 00 00 00 00    TE1.00..........
   0040: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
   0050: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
   0060: 43 68 61 70 74 65 63 20 42 72 69 64 67 65 20 4C    Chaptec Bridge L
   0070: 34 32 31 20 20 20 20 20 00 00 00 00 00 00 00 00    421     ........
   0080: 00 00 00 53 44 52 20 20 20 20 20 47 45 4D 32 30    ...SDR     GEM20
   0090: 30 20 20 20 20 20 20 20 20 20 20 32 20 20 20       0          2
  Inquiry EVPD Page #00h
   0000: 7F 00 03 02 9B 00                                  ......
  SAF-TE Enclosure dump:
   Cooling/Fan #0: Operational
   Cooling/Fan #1: Operational
```

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```
   Cooling/Fan #2: Not Installed (Reserved for future use)
   Power Supply #0 : Operational (Turned on)
   Power Supply #1 : Malfunctioning (Commanded on)
   Power Supply #2 : Not Installed (Reserved slot)
   Device in slot #0: Empty slot
   Device in slot #1: Empty slot
   Device in slot #2: Activated (SCSI ID is 02h)
   Device in slot #3: Activated (SCSI ID is 03h)
   Device in slot #4: Empty slot
   Device in slot #5: Activated (SCSI ID is 05h)
   Door Lock #0: Unlocked (or no controllable lock installed
   Alarm Speaker #0: Off (or not installed)
   Temperature Sensor #0: 34C / 94F
Terminating program.
```

The text in RED printed as a result of the **-E+** option. The rest of the text printed because the **-I+** option was also selected.

- If you invoke the **-E** option, the program will run in the background and poll your SES compliant enclosure(s) at the same time it polls disk drives. If a problem is found, it generates an alert as specified by the command-line options. If you invoke the program with the **-E+** option, all of the current enclosure information will display and the program will terminate.
- There are additional informational fields that this program can report, providing your enclosure manufacturer reports that information to the SAF-TE electronics in their engine.
- If your SAF-TE enclosure supports the optional **SAF-TE power-on minutes** or **SAF-TE power-on cycles** data, we report that as well starting in revision 1.27.
- Version 1.28 added SAF-TE reporting capability for additional slot and array status reporting.

Below is the output that one might see in a log file or email alert before and after unplugging a power cable.

```
D:\msdevstd\projects>smartmon-ux -E -F 10 \\.\SCSI3:
SMARTMon-ux [Release 1.13, Build 4-SEP-2002] - Copyright 2002 SANtools, Inc. http://www.SANtools.com
*****************************************************************
* This is an evaluation license. The software will expire on      *
* Sun Sep 15 23:11:53 2002 (11 days).                             *
*****************************************************************
Discovered CNSi JSS122 S/N " " on \\.\SCSI3: (processor) [Adapter/ID.LUN=0/0.0]
Discovered CNSi JSS122 S/N " " on \\.\SCSI3: (processor) [SAF-TE] [Adapter/ID.LUN=0/0.6]
Program will poll every 10 seconds.
\\.\SCSI3: polled at Wed Sep 04 23:11:53 2002 Status:OK
\\.\SCSI3: polled at Wed Sep 04 23:12:03 2002 Status:OK
\\.\SCSI3: polled at Wed Sep 04 23:12:13 2002 Status:Critical - Power Supply #1  Malfunctioning (Commanded
on) CNSi JSS122
\\.\SCSI3: polled at Wed Sep 04 23:12:23 2002 Status:Critical - Power Supply #1  Malfunctioning (Commanded
on) CNSi JSS122
\\.\SCSI3: polled at Wed Sep 04 23:12:33 2002 Status:OK
^C
D:\msdevstd\projects>
```

1.12 Enclosure Services Reprogramming (SES)

This feature allows you almost full control of your SES enclosure and devices within it. We will let you send low-level commands to do anything you want to do such as decrease the fan speed or turn off the power supplies. Use this feature wisely. If you want to do something stupid like program all of the fans to get turned off and disable the thermal shutdown, SMARTMon-UX will let you submit those commands to your enclosure (which will probably be rejected as most SES engines will not let you do these things for obvious reasons).

This function is really for storage engineers, hardware designers, and other advanced users who would typically be very aware of how to directly program a SES enclosure, but require an application program that can facilitate this for them. These users would typically be very familiar with the ANSI SES programming specification, as well as programming vendor-unique fields that would not normally be available without a non-disclosure agreement between the end-user and the enclosure manufacturer.

Usage:

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`./smartmon-ux -EP2ttnnwwxxyy [-EP2ttnnwwxxyy] device_name`

Note, all numbers are two character hex digits, ranging from 0-9 or A-F. You may also combine multiple commands on the same line. This is the preferred way to combine multiple commands as all of them will get executed at the same time.

- **`tt`** - Element type. Represents either an ANSI-defined element type code or a vendor-unique type code. See the table below for a cross-reference.
- **nn** - Element number. This is the nth element of type tt. If you want to configure the overall settings for a specific element type, enter value FF for the element number. The first element number is always 00. So, if you wanted to address the ***first*** power supply, the beginning of the command option would be ***`-EP20200`***
- **ww xx yy** - These are the three bytes you want to send which correspond to byte offsets **1**, **2**, and **3** in the ***CommonControl*** field of SES Page #2.

`tt` = element number (in hex) that you wish to control. Range is 0 to n, where n is the highest element number **-EP2ttnnwwxxyy** Sends bytes ww,xx,yy to SES enclosure control page (#2) for element type tt number nn. This function is covered in detail in the next chapter, Enclosure Services Reprogramming

ANSI-Defined SES Element Types and Description Table

Element Type Code (hex)	Description
00	Unspecified *(Do not use it!!)*
01	Device (i.e., something in a slot like disk drive or DAT tape)
02	Power Supply
03	Cooling (typically a fan)
04	Temperature Sensor
05	Door Lock
06	Audible Alarm
07	Enclosure Services Controller Electronics
08	SCC Controller Electronics
09	Nonvolatile Cache
0A	Invalid Operation Reason
0B	Uninterruptible Power Supply
0C	Display (LCD display or control panel)
0D	Key Pad Entry
0E	Enclosure
0F	SCSI Port/Transceiver
10	Language Element
11	Communication Port
12	Voltage Sensor
13	Current Sensor
14	SCSI Target Port
15	SCSI Initiator Port
16	Simple Sub-enclosure
17	Array Device
18 - 7F	Reserved
80 - FF	Vendor-specific type code

Example:
Below is a table from the ANSI SES programming specification which shows how one might package the bytes to control aspects of a device. We will send a harmless command which will enable the fault light for a device in a particular slot. Every element type has a different 4-byte structure and options, so you should consult either the ANSI programming specification or your particular vendor's documentation. Remember, an enclosure manufacturer is free to not support certain functions as well as add vendor-unique functionality.

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Byte/Bit	7	6	5	4	3	2	1	0
0	Common Control (This is automatically set to zero)							
1 (ww field)	Reserved							
2 (xx field)	Active	Do Not Remove	Reserved		Request Insert	Request Remove	Request Identify	Reserved
3 (yy field)	Reserved		Request Fault	Device Off	Enable Bypass A	Enable Bypass B	Reserved	

To enable the request fault light, we must set bit 5 in byte #3 (i.e., 20 hex), so the ***wwxxyy sequence*** must be **`000020`**.
As we are controlling the device element, we must send a 01 to indicate a disk device. For our example, we'll select the third device in the enclosure (corresponding to element # 2).

Put it all together, and you would send out **`-EP20102000020`**.
If we were to send out **`-EP20102000200`**, this will turn off the fault light, but turn on the identify light (assuming one exists). Note that the fault light goes off because byte 3 (the yy field) has all zeros in it. The SES enclosure will stay in whatever state you put it in, until either the enclosure decides to override that state or power is reset to the enclosure. Everything is volatile. (There may be some exceptions for vendor-unique SES elements).

If you wanted to instruct the device to both request fault and force the bypass "A" path, and turn on the identify LED, then send **`-EP20102000228`**.

1.13 Enclosure Services Configurator (SES)

As of release 1.20, the administrator has the ability to control selected characteristics of a SES-compliant enclosure. Not all of the functions outlined in this chapter are supported by all enclosures. If you have any doubt whether or not a particular firmware revision of your SES enclosure supports a particular function, please contact your storage vendor.

SMARTMon-ux sends SES commands according to the ANSI specification, but the specification does not require a SES enclosure to support all of the functions which can be controlled by this software.

The following functions may be used together or in combination with other options with one or more enclosures on the same command line. In all of these commands, the letter "n" indicates the SES device number for the particular component. Per the ANSI SES specification, all devices start at unit zero. If you had a 16-disk enclosure, your disks would be numbered from 0 to 15.

Visual fault indicators are the LEDs (Light Emitting Diodes). Manufacturers are free to use multiple LEDs, multi-color LEDs, or single LEDs with different flashing frequencies to differentiate the indicators. Typically a manufacturer will assign a yellow LED for the fault indicator, and one or two LEDs for identification. This software sends the commands to control all possible LEDs defined by the ANSI SES specification. If you are unable to control individual LEDs with this software, then please contact us. We will work with the manufacturer to determine whether or not they utilize vendor-specific commands to control the control LEDs.

Some SES-compatible enclosures associate devices in the individual slots as array devices. The LSI SAS Shea enclosure is one example. The -EPL family of commands were added in release 1.36 to support them. You will not hurt anything by trying to control the various visual fault LEDs and send an unsupported command. The enclosure will just ignore it. However, you should not attempt to use this software to turn off fans or power supplies on a production system unless you know what you are doing, as some SES enclosures will freely let you turn off all of the fans and/or power supplies.

Note also that all commands are case sensitive. In most cases, the capital letter instructs program to turn on a feature, while the lower-case letter in the option instructs the feature to be turned off.

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-EPAMn Mute audible alarm #n
-EPAmn Un-mute audible alarm #n
-EPARn Set alarm #n to reminder mode
-EPArn Clear alarm #n from reminder mode
-EPATxn Set alarm tone urgency control for alarm #n to x, where x is hex value 0 - F
(The vast majority of SES enclosures only support one or two tones. You may need to experiment with the values).
-EPDFn Enable visual fault indicator for device in slot #n
-EPDfn Disable visual fault indicator for device in slot #n
-EPDIn Identifies device in Slot #n
-EPDin Disable identification for device in Slot #n
-EPLFn Enable visual fault indicator for array device in slot #n
-EPLfn Disable visual fault indicator for array device in slot #n
-EPLIn Identifies array device in Slot #n
-EPLin Disable identification for array device in Slot #n
-EPLRn Enable visual rebuild indicator for array device in slot #n
-EPLrn Disable visual rebuild indicator for array device in slot #n
-EPLSn Enable visual remove indicator for array device in slot #n
-EPLsn Disable visual remove indicator for array device in slot #n
-EP2ttnnwwxxyy **Sends bytes ww, xx, yy to SES enclosure control page (#2) for element type tt number nn. This function is covered in detail in the next chapter, Enclosure Services Reprogramming.**

Additional notes:
It is much more efficient to control several things with a single command. Therefore, if you wanted to light up the first four fault lights and turn OFF the tenth fault light, send **smartmon-ux -EPDF0 -EPDF1 -EPDF2 -EPDF3 -EPDf9 devicename**

1.14 Enclosure Services Viewer (SES)

SCSI Enclosure Services, referred as SES in this document, is a command set that is used to manage and sense the state of the power supplies, cooling devices, displays, indicators, individual drives, and other non-SCSI elements installed in a fibre channel enclosure. If you have a SES-compliant enclosure, this software can decode and report this information.

SMARTMon-ux supports the following SES-related viewing parameters:

- **-E** Polls SES status for the selected device at the next polling interval. If smartmon-ux is running in the foreground, the status will appear on the screen. If the software is running in the background, SMARTMon-ux will continue to run in the background, and the results will be saved to the default logging location specified by the defaults and/or other run-time parameters.
- **-E+** Displays full alphanumeric SES dump. If you have an enclosure where we report vendor-unique data, you will see that also. Once everything is polled and reported, the program will terminate.
- **-EH** Displays hex dump of all SES configuration & status pages. You would ordinarily use this command to view vendor-unique data that we do not decode with the -E+ option. Once everything is polled and reported, the program will terminate.
- **-EF** Instructs the software to "discover" the SES information by a brute-force method, rather than invoking a SES command which will report what enclosure data is available. The -EF option was added reluctantly because we discovered an enclosure that was not ANSI compliant which rejected the query operation. If your enclosure does not report any SES information, but you are sure it has that capability, you should try adding the -EF to one of the above commands.

Unless you have a very inexpensive enclosure, your fibre-channel enclosure is probably SES-compliant. If you are not sure, run smartmon-ux with the **-E+** option and find out. Below is sample output from one of our enclosures when we

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unplugged one of the power supplies.

```
root@morph smartmon]# ./smartmon-ux -E+ /dev/sdc
SMARTMon-ux [Release 1.23, Build 30-NOV-2003] - Copyright 2003 SANtools, Inc. http://www.SANtools.com
Discovered SEAGATE ST336753FC S/N "3HX00LE3" on /dev/sdc [SES] (Not Enabling SMART)(35003 MB)
XYRATEX  RS1600-FC2-FFX2  WWN=20-00-00-50-CC-00-7B-8E:
Configuration switches numbered from 1-12 as viewed from rear, top to bottom
Vendor-specific features (Notes) [SWITCH SETTING]
 SoftSelect Mode             (Disabled) [SW11-OFF]
 Drive Speed                 (2 Gbit FC Mode)
 Loop Config                 (1 x 16 loop) [SW1-ON]
 Hub Mode                    (Enclosure in hub mode) [SW3-ON]
 Reserved                    (reserved) [SW4-OFF]
 SES Report                  (REPORT bit set on single)
 Power Redundancy Indication (Enclosure indicates redundancy)
 Ops Panel Muted Mode        (Enclosure in REMIND mode)
 Drive Addressing Mode:      0 (1 x 16 JBOD)
 Unit Select Switch:         1
 Model is: Goshawk - Mylex FFX2 RAID 2Gbit dual port controller
 Master LRC Firmware level:  35
 SFP Host 0 Present (LoopA): YES
 SFP Host 0 Good (A):        NO
 SFP Host 1 Present (A):     YES
 SFP Host 1 Good (A):        NO
 SFP Expansion Present (A):  NO
 SFP Expansion Good (A):     NO
 SFP Host 0 Present (LoopB): YES
 SFP Host 0 Good (B):        NO
 SFP Host 1 Present (B):     NO
 SFP Host 1 Good (B):        NO
 SFP Expansion Present (B):  YES
 SFP Expansion Good (B):     NO
Device #0 OK SelID=04h [Row=1 Col=1]
Device #1 Not Installed SelID=05h [Row=1 Col=2]
Device #2 OK SelID=06h [Row=1 Col=3]
Device #3 Not Installed SelID=07h [Row=1 Col=4]
Device #4 Not Installed SelID=08h [Row=2 Col=1]
Device #5 Not Installed SelID=09h [Row=2 Col=2]
Device #6 Not Installed SelID=0ah [Row=2 Col=3]
Device #7 Not Installed SelID=0bh [Row=2 Col=4]
Device #8 Not Installed SelID=0ch [Row=3 Col=1]
Device #9 Not Installed SelID=0dh [Row=3 Col=2]
Device #10 Not Installed SelID=0eh [Row=3 Col=3]
Device #11 Not Installed SelID=0fh [Row=3 Col=4]
Device #12 OK SelID=10h [Row=4 Col=1]
Device #13 Not Installed SelID=11h [Row=4 Col=2]
Device #14 OK SelID=12h [Row=4 Col=3]
Device #15 OK SelID=13h [Row=4 Col=4]
Power Supply #0 Critical DC Undervoltage AC failure DC failure [LED ON]
Power Supply #1 OK
Cooling Element #0 OK fan at speed 4
Cooling Element #1 OK fan at speed 4
Temperature Sensor #0 OK 104F/40C
Audible Alarm #0 OK ENABLED sounding CRITICAL
SESElectronics Processor #0 OK [ACTIVE]
SESElectronics Processor #1 OK [PASSIVE]

Threshold Information                  Warning Range   Critical Range
Temperature Sensor #0:                   30 - 74         20 - 78

Module Locations - Front View
  Col-1     Col-2     Col-3     Col-4
+-------------------------------------+
|Dev #00 | Dev #01 | Dev #02 | Dev #03 | Row-1
|Dev #04 | Dev #05 | Dev #06 | Dev #07 | Row-2
|Dev #08 | Dev #09 | Dev #10 | Dev #11 | Row-3
|Dev #12 | Dev #13 | Dev #14 | Dev #15 | Row-4
+-------------------------------------+

Module Locations - Rear View
+-------------------------------------+
```

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```
| PSU /    | 2nd | 1st |OPS   | PSU /   |
| Cooling  | LRC | LRC |Panel| Cooling |
| First    | 'B' | 'A' |      | Second  |
|   #0     | #1  | #0  |      |  #1     | <--SES ID#
+-------------------------------------+

 Legend for Below: SN=Serial#, (optional)SC=Status Code
  LRC-A: SN=PMT317000005619
  LRC-B: SN=PMT317000005396
  Power Supply#1: SN=IMS4204300008BB
  Power Supply#2: SN=IMS4204300007F7

Program Ended.
```

- The text in **RED** represents the typical output that you would have regardless of your enclosure manufacturer. This is the result of decoding only the ANSI-defined information. The **BLUE** text represents additional information that might appear if you had an enclosure manufactured by Xyratex.
- If you invoke smartmon-ux with the **-E** option, the program will run in the background and poll your SES compliant enclosure(s) at the same time it polls disk drives. If a problem is found, it generates an alert as specified by the command-line options. If you invoke the program with the **-E+** option, all of the current enclosure information will display and the program will terminate.
- There are dozens of additional informational fields that this program can report, providing your enclosure manufacturer reports that information to the SES electronics in their engine. Our software reports all **SES elements** 35 defined in the specification.

Here is the output from a HP A6214 enclosure for comparison. This enclosure implements SES differently, as it exposes a SES-specific Fibre Channel ID. The Xyratex enclosure implemented SES services via a pass-through disk drive. Both methods are defined by the ANSI specification, and both are supported by our software.

```
Discovered HP A6214A S/N "R16RH1394676" on /dev/rscsi/c4t15d0 [SES] (Enclosure Services)
HP       A6214A          WWN=50-06-0B-00-00-0C-62-8A:
Device #0 OK Slot=00h
Device #1 OK Slot=01h
Device #2 OK Slot=02h
Device #3 Not Available Slot=03h
Device #4 OK Slot=04h
Device #5 OK Slot=05h
Device #6 OK Slot=06h
Device #7 OK Slot=07h
Device #8 OK Slot=08h
Device #9 OK Slot=09h
Device #10 OK Slot=0ah
Device #11 OK Slot=0bh
Device #12 OK Slot=0ch
Device #13 OK Slot=0dh
Device #14 OK Slot=0eh
Power Supply #0 OK
Power Supply #1 OK
Cooling Element #0 OK fan at speed 4
Cooling Element #1 OK fan at speed 4
Temperature Sensor #0 OK 93F/34C
Temperature Sensor #1 OK 95F/35C
Audible Alarm #0 OK ENABLED
SESElectronics Processor #0 OK [ACTIVE]
SESElectronics Processor #1 OK [PASSIVE]
SCSIPort #0 OK This device did NOT participate in transmission of SES info [Link DOWN]
SCSIPort #1 OK This device did NOT participate in transmission of SES info [Link UP]
SCSIPort #2 OK This device did NOT participate in transmission of SES info [Link DOWN]
SCSIPort #3 OK This device did NOT participate in transmission of SES info [Link DOWN]
VoltageSensor #0 OK Input voltage  33.2 VAC RMS
VoltageSensor #1 OK Input voltage  51.2 VAC RMS
VoltageSensor #2 OK Input voltage 121.6 VAC RMS
VoltageSensor #3 OK Input voltage  33.2 VAC RMS
VoltageSensor #4 OK Input voltage  51.6 VAC RMS
VoltageSensor #5 OK Input voltage 122.4 VAC RMS
VendorSpecific Device (80) Status: 01 00 00 00
VendorSpecific Device (81) Status: 01 00 01 00
```

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Note that this devices contains some vendor-specific information and supports a few more sensors (primarily voltage).

Other SES Information
In addition to the information you see above, this software reports and decodes SES Pages 5 (SES Threshold Page), SES Page 6 (SES Array Status Page), SES Page 3 (SES Help Text), SES Page 7 (SES Descriptor Text), SES Page A (SES Array) Not all enclosures report all of this information. See the Vendor-unique enclosure information 41 screen for some sample dumps.

1.14.1 Vendor-Unique Enclosure Data

There is a significant amount of code (several thousand lines) in SMARTMonUX to deal with reporting vendor-unique data from a variety of SES-compliant enclosure manufacturers. Furthermore, as enclosure manufacturers typically sell into the OEM and reseller marketplace, having access to this information can provide you valuable information which might not be available through tools offered by your subsystem supplier.

Below is a list of information on enclosure manufacturers and ***some*** of the vendor-unique information that we report. If your manufacturer is not listed, it is still quite probable that a significant amount of hidden, vendor-unique data will still be reported ... *information that is NOT available via programs supplied by your storage vendor*. That is because the vast majority of storage vendors do not make their own enclosures, rather they select off-the-shelf or customized SES-compliant enclosures from one of a small family of enclosure manufacturers and brand it as their own. Because of non-disclosure constraints, we cannot reveal all of the products we provide additional information on, but we can provide the following information:

Make	Model(s)	Vendor-Unique Data/Notes (All returned with -E+ 37 unless otherwise noted)
DotHill 43	SANnet 2 SANnet II SANnet 1	• Fan RPM details (cross references speed setting with actual RPMs)
Intel	McKay Creek 45 Intel Storage Server family computers (SSR212MC and SSR212MC2)	• CPU temperature, DIMMs, Motherboard
LSI 41	Pro Fibre Family 41 Shea SAS/SATA Family 42	• Feature code and serial numbers for SES elements • Feature codes, all serial numbers of components and full configuration information
Newisys	2240 and 2241 family of SAS enclosures	• Feature code and serial numbers for SES elements • Feature codes, all serial numbers of components and full configuration information
Xyratex	Salient Family, SAS EBOD family	• Everything
Xyratex	Goshawk (16 & 12 bays) includes enclosures with RAID engines	• LRC or ESH firmware and part no • Most dip switch settings • In & Out Port, Host, Loop and Expansion present and good status where applicable. • SES Device layout map - device slot and module locations • FRU information
Xyratex	Osprey / Hawk (14 bays)	• LRC or ESH firmware and part no • OPS firmware, type and part no • Enclosure serial number • Device layout map - device slot and module locations • FRU information
Xyratex 45	All switched ("Firebird" equipped enclosures) also display this info	• Firebird-equipped switching enclosures also report: • Hex dump of ESH pages 80h - 85h (-EH 37) • Element 80 status text is polled (-E 37 and -E+ 37) • ESH Port A/B Event status pages 80h & 81h for each device and host.

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Make	Model(s)	Vendor-Unique Data/Notes (All returned with -E+ 37 unless otherwise noted)
		Includes error counters, utilization %, and clock information. • ESH Port A/B Config pages 82h & 83h which includes error thresholds, status bits, and global control settings • ESH Loop A/B Config pages 86h & 87h
All	All	• ASCII Hex bytes for all vendor-unique elements while polling (-E 37)

Output from Various SES Enclosures (We changed only the serial and WWN numbers for privacy reasons).

Sun SES Enclosure

```
SUNWGS INT FCBPL WWN=50-80-02-00-00-88-88-88:
Device #0 OK Slot=00h
Device #1 OK Slot=01h
Device #2 Not Installed Slot=02h
Device #3 OK Slot=03h
Device #4 Not Installed Slot=04h
Device #5 Not Installed Slot=05h
Device #6 Unsupported Slot=08h
Device #7 Unsupported Slot=09h
Device #8 Unsupported Slot=0ah
Device #9 Unsupported Slot=0bh
Device #10 Unsupported Slot=0ch
Device #11 Unsupported Slot=0dh
Temperature Sensor #0 OK 81F/27C
Temperature Sensor #1 Not Installed
SSC100 (Base Backplane)      #0 OK
SSC100 (Base LoopB)          #1 OK
SSC100 (Expansion Backplane) #2 Not Installed
SSC100 (Expansion LoopB)     #3 Not Installed
Language Element #0 Unsupported
SES Firmware Revision:        "9226"

Element Type Descriptors Information
Device                          = "Disks - 6 Base (Std), 6 Expansion (Opt)"
Temperature Sensor              = "Temperature Sensors - 0 Base, 1 Expansion"
VendorUnique Element (82)       = "SSC100's - 0=Base Bkpln, 1=Base LoopB, 2=Exp Bkpln, 3=Exp LoopB"
Language Element                = "Default Language is USA English, ASCII"


Element Descriptors Information
SSC100 (Base Backplane)      (0)         "9226/ FD99 9"
SSC100 (Base LoopB)          (1)         "9226/ FD99 0"
SSC100 (Expansion Backplane) (2)         "0000/ 0000 0"
SSC100 (Expansion LoopB)     (3)         "0000/ 0000"
```

LSI (formerly IBM) ProFibre

```
LSI DF4000J  WWN=20-00-00-80-E5-88-88-88:
Device #0 OK Slot=00h
Device #1 OK Slot=01h
Device #2 OK Slot=02h
Device #3 OK Slot=03h
Device #4 OK Slot=04h
Device #5 OK Slot=05h
Device #6 OK Slot=06h
Device #7 Not Installed Slot=07h
Device #8 Not Installed Slot=08h
Device #9 Not Installed Slot=09h
Device #10 Not Installed Slot=0ah
Device #11 Not Installed Slot=0bh
Device #12 Not Installed Slot=0ch
Device #13 Not Installed Slot=0dh
Device #14 OK Slot=0eh
Power Supply #0 OK
Power Supply #1 OK
Cooling Element #0 OK fan at lowest speed
Cooling Element #1 OK fan at lowest speed
```

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```
Cooling Element #2 OK fan at lowest speed
Temperature Sensor #0 OK 106F/41C
Temperature Sensor #1 OK 99F/37C
SESElectronics Processor #0 OK [ACTIVE]
SESElectronics Processor #1 OK [PASSIVE]
SES Firmware Revision:        "0310"

Element Descriptors Information
Power Supply (0)                        "FN  07N2030 SN  1Z3YE1C8888"
Power Supply (1)                        "FN  07N2030 SN  1Z3YE23Z888"
Cooling Element (0)                     "FN  07N2030 SN  1Z3YE1C7777"
Cooling Element (1)                     "FN  07N2030 SN  1Z3YE23Z888"
Cooling Element (2)                     "FN  07N2029 SN  1Z3YC1C9999"
SESElectronics Processor (0)            "FN  07N2026 SN  1Z3Y61C8888"
SESElectronics Processor (1)            "FN  07N2026 SN  1Z3Y61C9999"


Threshold Information                  Warning Range   Critical Range
Temperature Sensor #0:                   35 - 74          28 - 78
Temperature Sensor #1:                   35 - 74          28 - 78
```

LSI SAS Shea Enclosure

```
LSILOGIC SYM3600-SAS WWN=10-00-00-A0-B8-1D-2A-84:
Vendor-specific features (Notes)
 Backplane FRU P/N:           PN 14617-01RWK
 System serial number:        SN 0617053320
 FRU vendor:                  VN ENGENIO
 FRU manufacture date:        DT 05/2006
 FRU type:                    FT MIDPLANE
 ESM P/N:                     PN 21204-06
 ESM serial number:           SN SX70500654
 ESM vendor:                  VN ENGENIO
 ESM manufacture date:        DT 02/2007
 ESM type:                    FT 3600_ESM
 PSU(0) P/N:                  PN 14572-05
 PSU(0) serial number:        SN ZST061400474
 PSU(0) vendor:               VN ENGENIO
 PSU(0) manufacture date:     DT 04/2006
 PSU(0) type:                 FT PWRSUPLY
 PSU(1) P/N:                  PN 14572-05
 PSU(1) serial number:        SN ZST061400486
 PSU(1) vendor:               VN ENGENIO
 PSU(1) manufacture date:     DT 04/2006
 PSU(1) type:                 FT PWRSUPLY
ArrayDevice #0 OK SelID=00h [Row=1 Col=1]
ArrayDevice #1 OK SelID=00h [Row=1 Col=2]
ArrayDevice #2 OK SelID=00h [Row=1 Col=3]
ArrayDevice #3 OK SelID=00h [Row=1 Col=4]
ArrayDevice #4 Not Installed SelID=00h [Row=2 Col=1]
ArrayDevice #5 OK SelID=00h [Row=2 Col=2]
ArrayDevice #6 Not Installed SelID=00h [Row=2 Col=3]
ArrayDevice #7 Not Installed SelID=00h [Row=2 Col=4]
ArrayDevice #8 Not Installed SelID=00h [Row=3 Col=1]
ArrayDevice #9 Not Installed SelID=00h [Row=3 Col=2]
ArrayDevice #10 Not Installed SelID=00h [Row=3 Col=3]
ArrayDevice #11 OK SelID=00h [Row=3 Col=4]
Enclosure #No visual failure indication,No visual warning indication,No failure requested,No warning
requested
SESElectronics Processor #0 OK [ACTIVE]
SESElectronics Processor #1 OK [PASSIVE]
Temperature Sensor #0 OK 81F/27C
Temperature Sensor #1 OK 81F/27C
Temperature Sensor #2 OK 82F/28C
Temperature Sensor #3 OK 77F/25C
Cooling Element #0 OK fan at speed 3 [actual speed 3450 rpm]
Cooling Element #1 OK fan at speed 3 [actual speed 3500 rpm]
Cooling Element #2 OK fan at speed 3 [actual speed 3720 rpm]
Cooling Element #3 OK fan at speed 3 [actual speed 3770 rpm]
Power Supply #0 OK
Power Supply #1 OK
VoltageSensor #0 OK  Input voltage 116.2 VAC RMS
```

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```
VoltageSensor #1 OK  Input voltage  33.0 VAC RMS
VoltageSensor #2 OK  Input voltage  33.0 VAC RMS
VoltageSensor #3 OK  Input voltage  17.9 VAC RMS
VoltageSensor #4 OK  Input voltage  17.9 VAC RMS
VoltageSensor #5 OK  Input voltage  12.0 VAC RMS
VoltageSensor #6 OK  Input voltage  11.9 VAC RMS
Tray #0 0 OK TrayID=2
SES Firmware Revision:       "0166"

Element Type Descriptors Information
SESElectronics Processor         = "3"
Tray                             = "Shea Tray"


Element Descriptors Information
Array Device (0)                         "SLOT 01"
Array Device (1)                         "SLOT 02"
Array Device (2)                         "SLOT 03"
Array Device (3)                         "SLOT 04"
Array Device (4)                         "SLOT 05"
Array Device (5)                         "SLOT 06"
Array Device (6)                         "SLOT 07"
Array Device (7)                         "SLOT 08"
Array Device (8)                         "SLOT 09"
Array Device (9)                         "SLOT 10"
Array Device (10)                        "SLOT 11"
Array Device (11)                        "SLOT 12"
Enclosure (0)                            "ENCLOSURE 02"
3 (0)                                    "PN 21204-06     SN SX70500654   VN ENGENIO  DT 02/2007  FT
3600_ESM"
3 (1)                                    "PN 21204-06     SN SX70500665   VN ENGENIO  DT 02/2007  FT
3600_ESM"
Power Supply (0)                         "PN 14572-05     SN ZST061400474 VN ENGENIO  DT 04/2006  FT
PWRSUPLY"
Power Supply (1)                         "PN 14572-05     SN ZST061400486 VN ENGENIO  DT 04/2006  FT
PWRSUPLY"
Shea Tray (0)                            "PN 14617-01RWK  SN 0617053320   VN ENGENIO  DT 05/2006  FT
MIDPLANE"


Module Locations - Front View
  Col-1     Col-2     Col-3     Col-4
+-------------------------------------+
|SLOT 01 | SLOT 02 | SLOT 03 | SLOT 04 | Row-1
|SLOT 05 | SLOT 06 | SLOT 07 | SLOT 08 | Row-2
|SLOT 09 | SLOT 10 | SLOT 11 | SLOT 12 | Row-3
+-------------------------------------+
     Module Locations - Rear View
+-------------------------------------+
| PSU / Cooling    |  PSU / Cooling    |
| First            |  Second  #1       |
+-------------------------------------+

Internal Device Information
 Bay  Type     SAS Expander Address       SAS Device Address
------------------------------------------------------------
   1   SAS  50-0A-0B-82-E0-89-40-00  50-00-C5-00-06-94-C6-E9
   2   SAS  50-0A-0B-82-E0-89-40-00  50-00-C5-00-06-94-BE-85
   3   SAS  50-0A-0B-82-E0-89-40-00  50-00-C5-00-06-94-BB-79
   4   SAS  50-0A-0B-82-E0-89-40-00  50-00-C5-00-06-94-BE-AD
   6   SAS  50-0A-0B-82-E0-89-40-00  50-00-C5-00-06-94-C0-DD
  12   SAS  50-0A-0B-82-E0-89-40-00  50-00-C5-00-06-94-BF-FD
```

DotHill

```
DotHill  ERMFC SANnet  WWN=20-20-00-C0-FF-88-88-88:
Device #0 OK Slot=00h
Device #1 OK Slot=01h
Device #2 OK Slot=02h
Device #3 OK Slot=03h
Device #4 OK Slot=04h
```

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```
Device #5 OK Slot=05h
Device #6 OK Slot=06h
Device #7 OK Slot=07h
Device #8 OK Slot=08h
Device #9 OK Slot=09h
Device #10 OK Slot=ffh
Device #11 OK Slot=ffh
Power Supply #0 OK
Power Supply #1 OK
Power Supply #2 OK
Cooling Element #0 OK fan at intermediate speed
Cooling Element #1 OK fan at intermediate speed
Cooling Element #2 OK fan at intermediate speed
Temperature Sensor #0 OK 75F/24C
Temperature Sensor #1 OK 84F/29C
Temperature Sensor #2 OK 77F/25C
Temperature Sensor #3 OK 79F/26C
Temperature Sensor #4 OK 72F/22C
Temperature Sensor #5 OK 88F/31C
Temperature Sensor #6 OK 84F/29C
Audible Alarm #0 OK ENABLED
NonvolatileCache Unit #Unsupported
Language Element #0 Unsupported
VoltageSensor #0 OK  Input voltage  53.0 VAC RMS
VoltageSensor #1 OK  Input voltage 122.7 VAC RMS
VoltageSensor #2 OK  Input voltage  53.0 VAC RMS
VoltageSensor #3 OK  Input voltage 122.8 VAC RMS
VoltageSensor #4 OK  Input voltage  53.0 VAC RMS
VoltageSensor #5 OK  Input voltage 122.8 VAC RMS
VoltageSensor #6 OK  Input voltage  50.3 VAC RMS
VoltageSensor #7 OK  Input voltage 120.2 VAC RMS
VoltageSensor #8 Unsupported
VoltageSensor #9 Unsupported
Event Reporting Module Cards #0 OK
Event Reporting Module Cards #1 OK
Drive I/O Cards #0 OK
Drive I/O Cards #1 Non-Critical
Host I/O Cards #0 OK
Host I/O Cards #1 Not Installed
Host I/O Cards #2 OK
Host I/O Cards #3 Not Installed
SES Firmware Revision:        "B300"

Help Text
For questions regarding the SANnet FC, please contact Dot Hill Systems Technical Support at +1 (212)
989-4455
or toll-free (800) 727-3836 in the U.S.

Element Type Descriptors Information
Device                          = "Disk Drives and RAID Controllers"
Power Supply                    = "Power Supplies"
Cooling Element                 = "Cooling Fans"
Temperature Sensor              = "Temperature Sensors"
Audible Alarm                   = "Alarm"
NonvolatileCache Unit           = "EEPROM"
Language Element                = "Language"
VoltageSensor                   = "Power Supply Voltage Sensors"
VendorUnique Element (80)       = "Event Reporting Module Cards"
VendorUnique Element (81)       = "Drive I/O Cards"
VendorUnique Element (82)       = "Host I/O Cards"


Threshold Information                 Warning Range   Critical Range
Temperature Sensors #0:                 22 - 65         20 - 75
Temperature Sensors #1:                 22 - 65         20 - 75
Temperature Sensors #2:                 22 - 65         20 - 75
Temperature Sensors #3:                 22 - 65         20 - 75
Temperature Sensors #4:                 22 - 65         20 - 75
Temperature Sensors #5:                 22 - 65         20 - 75
Temperature Sensors #6:                 22 - 65         20 - 75
```

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XYRATEX SBOD & EBOD (1603)
(Not shown)

1.14.2 Intel SSR212MC2 Enclosure

The software now enumerates Intel's McKay Creek family of enclosures. This product is also known as the Intel Storage Server SSR212MC2. Unlike the bundled software that Intel supplies, smartmon-ux supports Solaris, all 64-bit windows variants, and numerous 32/64-bit LINUX variants. SMARTMon-UX is capable of providing full control, configuration, and monitoring. It will also provide flexibility to use "unsupported" peripherals and controllers, let you manually or automatically manipulate the LEDs and audible alarms using the standard -EPxx family commands 35.

Below is the full SES dump as seen on a system running a custom 64-bit kernel
(Note: We discovered a firmware bug in build B55 of the firmware. As of June 2008, they have acknowledge the defect, and are working on a fix. Specifically, the system is not reporting temperature for CPU1).

```
# /etc/smartmon-ux -E+ /dev/sg13
SMARTMon-UX [Release 1.36, Build 30-JUN-2008] - Copyright 2001-2008 SANtools(R), Inc. http://www.SANtools.
com
Enclosure fault on Intel    SSR212MC        WWN=50-05-0C-C1-01-AB-C7-00:
ArrayDevice #0 OK SelID=00h [Row=1 Col=1]
ArrayDevice #1 OK SelID=00h [Row=1 Col=2]
ArrayDevice #2 OK SelID=00h [Row=1 Col=3]
ArrayDevice #3 OK SelID=00h [Row=1 Col=4]
ArrayDevice #4 OK SelID=00h [Row=2 Col=1]
ArrayDevice #5 OK SelID=00h [Row=2 Col=2]
ArrayDevice #6 OK SelID=00h [Row=2 Col=3]
ArrayDevice #7 OK SelID=00h [Row=2 Col=4]
ArrayDevice #8 OK SelID=00h [Row=3 Col=1]
ArrayDevice #9 OK SelID=00h [Row=3 Col=2]
ArrayDevice #10 OK SelID=00h [Row=3 Col=3]
ArrayDevice #11 OK SelID=00h [Row=3 Col=4]
Power Supply #0 OK
Power Supply #1 Not Installed
Cooling Element #0 OK fan at 80% speed [actual speed 9300 rpm]
Cooling Element #1 OK fan at 80% speed [actual speed 9900 rpm]
Cooling Element #2 OK fan at 80% speed [actual speed 9100 rpm]
Cooling Element #3 OK fan at 80% speed [actual speed 10000 rpm]
Cooling Element #4 OK fan at 80% speed [actual speed 9300 rpm]
Cooling Element #5 OK fan at 80% speed [actual speed 10000 rpm]
Cooling Element #6 OK fan at 80% speed [actual speed 9400 rpm]
Cooling Element #7 OK fan at 90% speed [actual speed 10500 rpm]
Cooling Element #8 OK fan at 80% speed [actual speed 9100 rpm]
Cooling Element #9 OK fan at 80% speed [actual speed 10000 rpm]
Temperature Sensor #0 OK 84F/29C
Temperature Sensor #1 OK 79F/26C
Temperature Sensor #2 OK 99F/37C below cpu threshold
Temperature Sensor #3 Not Installed
Temperature Sensor #4 OK 97F/36C
Temperature Sensor #5 OK 79F/26C below cpu threshold
DoorLock #0 OK LOCKED
Audible Alarm #0 OK ENABLED
SESElectronics Processor #0 OK [PASSIVE]
SESElectronics Processor #1 OK [PASSIVE]
SESElectronics Processor #2 OK [PASSIVE]
SESElectronics Processor #3 OK [PASSIVE]
SESElectronics Processor #4 OK [PASSIVE]
SESElectronics Processor #5 OK [PASSIVE]
SESElectronics Processor #6 OK [PASSIVE]
Display Unit #0 OK OFF [Amber fault LED]
Display Unit #1 OK OFF [Blue chassis ID LED]
SAS Connector #0 N/A
T10 Compliance #0 OK [T10 compliance=OFF, Acoustic Mode=Unsupported]
SES Firmware Revision:       "3155"

Element Descriptors Information
Array Device (0)                        "Dk0"
Array Device (1)                        "Dk1"
```

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```
Array Device (2)                        "Dk2"
Array Device (3)                        "Dk3"
Array Device (4)                        "Dk4"
Array Device (5)                        "Dk5"
Array Device (6)                        "Dk6"
Array Device (7)                        "Dk7"
Array Device (8)                        "Dk8"
Array Device (9)                        "Dk9"
Array Device (10)                       "Dk10"
Array Device (11)                       "Dk11"
Power Supply (0)                        "PSUL"
Power Supply (1)                        "PSUU"
Cooling Element (0)                     "Fn0"
Cooling Element (1)                     "Fn1"
Cooling Element (2)                     "Fn2"
Cooling Element (3)                     "Fn3"
Cooling Element (4)                     "Fn4"
Cooling Element (5)                     "Fn5"
Cooling Element (6)                     "Fn6"
Cooling Element (7)                     "Fn7"
Cooling Element (8)                     "Fn8"
Cooling Element (9)                     "Fn9"
Temperature Sensor (0)                  "Int"
Temperature Sensor (1)                  "Ext"
Temperature Sensor (2)                  "CPU0"
Temperature Sensor (3)                  "CPU1"
Temperature Sensor (4)                  "Mobo"
Temperature Sensor (5)                  "DIMM"
SESElectronics Processor (0)            "EMC/CPLD Ver-0x3-0x1"
SESElectronics Processor (1)            "01A"
SESElectronics Processor (2)            "Intel Starlake S5000PSL"
SESElectronics Processor (3)            "Woodcrest Xeon"
SESElectronics Processor (4)            "Woodcrest Xeon"
SESElectronics Processor (5)            "IntelSRCSAS144E"
SESElectronics Processor (6)            "DIMM"
Display Unit (0)                        "Flt"
Display Unit (1)                        "ID"
SAS Expander (0)                        "Exp"
T10 Compliance (0)                      "T10"


Threshold Information                  Warning Range   Critical Range
Temperature Sensor #0:                   16 - 42          16 - 44
Temperature Sensor #1:                    8 - 33           8 - 35
Temperature Sensor #2:                  158 - 253        142 - 254
Temperature Sensor #3:                  158 - 253        142 - 254
Temperature Sensor #4:                   16 - 63          16 - 65
Temperature Sensor #5:                  158 - 253        142 - 254

Module Locations - Front View
  Col-1     Col-2     Col-3     Col-4
+-------------------------------------+
|SLOT 00 | SLOT 01 | SLOT 02 | SLOT 03 | Row-1
|SLOT 04 | SLOT 05 | SLOT 06 | SLOT 07 | Row-2
|SLOT 08 | SLOT 09 | SLOT 10 | SLOT 11 | Row-3
+-------------------------------------+
     Module Locations - Rear View
+-------------------------------------+
| PSU1/ Cooling    | Rest of system IO |
| PSU0/ Cooling    | ports from Mobo   |
+-------------------------------------+

Internal Device Information
 Bay  Type     SAS Expander Address       SAS Device Address
------------------------------------------------------------
   1  SATA  50-05-0C-C1-01-AB-C7-00  50-05-0C-C1-01-AB-C7-01
   2  SATA  50-05-0C-C1-01-AB-C7-00  50-05-0C-C1-01-AB-C7-02
   3  SATA  50-05-0C-C1-01-AB-C7-00  50-05-0C-C1-01-AB-C7-03
   4  SATA  50-05-0C-C1-01-AB-C7-00  50-05-0C-C1-01-AB-C7-04
   5  SATA  50-05-0C-C1-01-AB-C7-00  50-05-0C-C1-01-AB-C7-05
   6  SATA  50-05-0C-C1-01-AB-C7-00  50-05-0C-C1-01-AB-C7-06
```

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```
  7  SATA  50-05-0C-C1-01-AB-C7-00  50-05-0C-C1-01-AB-C7-07
  8  SATA  50-05-0C-C1-01-AB-C7-00  50-05-0C-C1-01-AB-C7-08
  9  SATA  50-05-0C-C1-01-AB-C7-00  50-05-0C-C1-01-AB-C7-09
 10  SATA  50-05-0C-C1-01-AB-C7-00  50-05-0C-C1-01-AB-C7-0A
 11  SATA  50-05-0C-C1-01-AB-C7-00  50-05-0C-C1-01-AB-C7-0B
```

1.15 Flash Firmware

This feature, introduced in build 1.22, allows you to flash firmware on selected SCSI, SAS, and Fibre channel family peripherals. It is not limited to disk drives.

Usage

smartmon-ux -flash [-confirm] FirmwareImageFile Device_list 22

If you provide the name of more than one device in the list, the program will continue to flash all devices in the list, after the first disk is flashed. If there is a problem with flashing any disk, the program immediately terminates with an appropriate error message. (If it is a result of a disk error, sense information will be provided to lend insight into the problem).

Example (Flashing a 73 GB Seagate U320 Cheetah disk with Firmware revision "0005"

```
[root@rh90 smartmon]# ./smartmon-ux -flash /tmp/0005.LOD /dev/sdc
SMARTMon-ux [Release 1.22, Build 22-AUG-2003] - Copyright 2003 SANtools, Inc. http://www.SANtools.com
Discovered SEAGATE ST373307LC S/N "3HZ0381E" on /dev/sd2 (Not Enabling SMART)(70007 MB)

*******************************************************************************
* Warning:  You have instructed the operating system to flash firmware. No checks will *
*           be made to verify that the device you plan to flash isn't mounted or in   *
*           use in any way.                                                           *
*                                                                                     *
*           Once the firmware image has been uploaded, then it may take a few minutes *
*           for the target device to save the new firmware and reboot. If you are     *
*           flashing a disk drive then it will spin down then up. Some devices are    *
*           vulnerable during this phase, and if you lose power during the reboot,    *
*           then they may be left without a valid firmware image, and will effectively *
*           become brain-dead. SANtools, Seagate, and other vendors formally specify  *
*           that you back up data before flashing firmware, and insure you have a UPS *
*           to prevent power loss.                                                    *
*                                                                                     *
*           If you provided a list of targets to flash, then they will be processed   *
*           in order, once each target device reboots after a successful update.      *
*                                                                                     *
*           As disks will appear dead to the O/S during the reboot, then you may see  *
*           some error messages, and have to force a device discovery.                *
*                                                                                     *
*           (LINUX typically requires you to rmmod and insmod the device driver, so   *
*           if you are booted to the same controller you are flashing disks on, then  *
*           you'll probably have to reboot the computer once all disks have spun up.) *
*                                                                                     *
*           You should also record all mode page settings before and after the flash  *
*           and make appropriate changes before placing the disk back in service.     *
*                                                                                     *
*           If you are attempting to flash an unsupported disk, or one pre-loaded with *
*           OEM firmware that relabels the disk's vendor/product IDs so it reports    *
*           it is made by another company, such as  Dell, EMC, NetApp,  or SUN, then  *
*           there is no guarantee that the image will be loaded.  If  the new firmware *
*           is rejected by the disk, then SMARTMon-UX will return with an appropriate *
*           error message.                                                            *
*******************************************************************************

Are you sure you want to do this, and is your data backed up? Answer "YES"

Do you wish to attempt to flash firmware temporarily, so the drive will revert to the original
firmware release once the disk is power-cycled?  This should be done if there is any
doubt of compatibility. (Not all disks and firmware release accept this technique).

Flashing  ............................... Sending final chunk - Completed
```

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```
Please allow sufficient time for drive to reset.

Terminating program.
```

(Note: LINUX users will also see the text below:)

```
"LINUX typically requires you to rmmod and insmod the device driver, so
if you are booted to the same controller you are flashing disks on, then
you'll probably have to reboot the computer once all disks have spun up.)"
```

Frequently Asked Questions

How does SMARTMon-UX identify firmware?

The program determines if you have a supported device by examining the vendor and product ID fields. If the vendor ID is "**SEAGATE**", we obviously have a Seagate disk, so no further checking is required. As some vendors change the vendor-ID to their own company name, but use stock firmware and stock models of disks, the program also assumes that any disk drive where the model starts with "**ST**" is also a Seagate drive, and the software will allow you to flash the disk. If the model number does not begin with "ST", chances are high that you have custom firmware which probably will not be compatible with this software.

If the disk drive manufacturer begins with "FUJ" (Fuji), and the model is a MAN or MAP family device, or the Vendor name is HITACHI, the program will be allowed to flash the firmware.

Can I convert a Seagate disk into an EMC or NetApp disk?

Don't waste your time. It won't work. You may *think* you have the right firmware image, but you don't. Vendors will not release firmware that turns a off-the-shelf disk into a branded EMC, NetApp, or other disk. The firmware images that these vendors supply are designed to check for the appropriate Vendor/Product IDs before the process begins. If the disk doesn't already report itself as a EMC disk, for example, then the update will fail.

How do I Obtain Firmware?

Contact your hardware vendor. Firmware (particularly Seagate firmware) is not in the public domain and is not normally posted online. We are not allowed, due to contractual limitations, to send firmware to anybody.

What are the Risks?

Worst case, you turn your disk drive into a paper weight. This can happen if power is interrupted between the time the firmware is downloaded into the disk, and while the disk is running the upgrade, which typically takes 1 - 5 minutes. Some firmware images are so large, that the disk cannot keep both copies resident. If the upgrade aborts, your disk has no firmware left to run. This is why you should always make sure your data is backed up. As many Seagate disk drives only have enough room for one firmware image, a failure means your disk will lose the firmware it currently has.

If you flash the wrong firmware image (and there can be dozens of images that will work for your disk), unpredictable things will happen. Your operating system may not communicate with the disk, the number of usable blocks could change, application software or your O/S could break because it is expecting certain identity strings that were changed, etc ...

If the drive's saved mode pages are different from the factory pages, this could cause problems for application software, RAID controllers, and so on. Always save mode page information before changing firmware, and make sure the mode page settings after the flash are appropriate. Sometimes Seagate makes changes to default and factory mode pages between firmware revisions.

You can decrease the risk by flashing the image in a temporary mode (see example). This places the new firmware in a volatile buffer, and after the disk does a warm reboot, it will be running the new firmware. Not all disks support this feature, but you will not harm disks in any way by attempting to see if the temporary flash is accepted. The temporary flashed disk will revert to the original firmware release after a power cycle.

With all of the Risk, Why Bother Upgrading Firmware in the First Place?

Skilled system administrators, disk subsystem manufacturers, resellers, OEMs, and VARs use this software, and are typically privy to disk firmware images and release notes that cover specifics of a new firmware image. They typically understand the risk/reward scenario, can assess whether or not a firmware upgrade (or downgrade) is appropriate and correct and know about mode pages. ***If you do not possess such knowledge and***

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experience, then do not flash new firmware. Have somebody that knows what they are doing to assist you.

I only have one disk, and I want to flash new firmware on it.
SMARTMon-UX does not care what disk you flash, other than checking to see if it is supported. If you want to flash your boot disk, and have it spin down for a few minutes and not service I/O commands, the software will not stand in your way. Your operating system will crash, of course, but it will probably work. Our recommendation is that you do not attempt this.

Will SANtools help me figure out what firmware I need, or where to get it?
No. We have no idea what firmware image you need. If you have to ask this question, we feel that you should not be changing firmware in the first place.

How do I know when the flash is complete?
Disks generally spin down, then a spin up to indicate the process has been completed. However, since drive manufacturers create custom firmware images for certain OEMs, the spin down/pinup cycle will not necessarily be seen everywhere. The best thing to do is consult the release notes, or just give it plenty of time (like 10 minutes for a 200+ GB model). Just because SMARTMon-UX returned to the O/S prompt, does not mean that the disk has completed the upgrade.

1.16 Flash SES Firmware

This allows you to flash firmware on SES compliant enclosures. The **`-flashses`** and **`-flashses7`** commands use different low-level SCSI command codes then the **`-flash`** 47 command.

Usage
```
smartmon-ux -flashses [-confirm] FirmwareImageFile Device_list 22
- or -
smartmon-ux -flashses7 [-confirm] FirmwareImageFile Device_list 22
```

The **`-flashses`** command performs a non-disruptive firmware update. This can be done while the enclosure is on-line, and the disk drives are servicing I/Os with live data. Engineers call this a mode E update. The enclosure will continue to use the old firmware until it is power-cycled. The new firmware will just stay dormant and the enclosure will continue to run with the older firmware. Unfortunately, not all enclosures (and firmware revisions) support this method. LSI enclosures, for example, only support the -flashses option once the enclosure is running a certain firmware revision.

We recommend trying the -flashses option first. The program will tell you if your enclosure rejected the update. If the update is rejected, then use the **`-flashses7`** command.

The **`-flashses7`** command uses the mode 7 update method. The firmware is sent to the enclosure, then the enclosure automatically reboots with the new firmware. If you have mounted disks in the enclosure, then I/O's may or may not be disrupted during the enclosure firmware update. You need to contact your enclosure vendor to determine if there is a risk of losing I/Os during an enclosure firmware update.

Frequently Asked Questions

How do I get the firmware file?
Contact your hardware vendor. Firmware is intellectual property of your vendor. We are not allowed, due to contractual limitations, to send firmware to anybody. You should also contact your vendor and find out if the enclosure and firmware you are currently running supports the Mode E method of updating firmware. If so, use the **`-flashses`** command instead of the **`-flashses7`** command. If your vendor support rep doesn't know, or won't tell you, then just try the -flashses command first. It won't hurt anything if the command is rejected.

What are the Risks?
Disk I/Os may be interrupted if you have to use the **`-flashses7`** command.

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If you flash the wrong firmware image, then unpredictable things will happen. Make sure you have the right firmware file. Read the release notes for the firmware update to determine if new firmware will do more harm than good.

Will SANtools help me figure out what firmware I need, or where to get it?
No. We have no idea what firmware image you need. If you have to ask this question, we feel that you should not be changing firmware in the first place.

Anything else I need to know?
SES enclosures typically have more than one processor (CPU device). You need to make sure you flash all SES processors.

1.17 Format Disk

The **-format** option, introduced in build 1.25 can be used to perform a low-level format of a SCSI, Fibre channel, or IBM SSA type disk drive. This command sends out the FORMAT UNIT command which performs a physical formatting of the disk drive. Depending on the options you supply, and the capabilities of the disk drive, you can use this feature to clear the grown defects (GLIST) table, change the layout of the remapped data or specify a certain data pattern to be written over the disk drive.

The **-format** option will only be accepted for disk drives. If you try to format a CDROM, for example, you will get an error. The command will also be rejected for ATA type disks as well, as there is arguably no reason why this command should ever be issued to an ATA family disk drive. Also, the command will only format one drive at a time, and the program will stay "locked up" until the operation has been completed. It will not send any additional commands to the drive until the format is complete. If your command-line uses wild-cards, or if you give it the device name for more than one disk drive, only the first disk will be selected for formatting.

Usage
```
smartmon-ux -format DeviceName
```

Example
```
C:\>smartmon-ux -format \\.\SCSI2Port2Path0Target19Lun0
SMARTMon-ux [Release 1.25-RC2, Build 13-MAR-2004] - Copyright 2001-2004 SANtools, Inc.
http://www.SANtools.com
*******************************************************************************
* Warning:  You have instructed the software to reformat the selected disk. No checks *
*           will be made to verify that the disk isn't mounted or in use in any way.  *
*           (Although reformatting your boot disk will blow the O/S, it will work.)   *
*                                                                                     *
*           The process could take several hours to complete, and this program will   *
*           lock up until either the formatting is complete or the drive rejects the  *
*           command.  Once the command is sent to the device, the software will       *
*           suspend and wait for the action to complete.                              *
*                                                                                     *
*           Your operating system may attempt to query the disk unless you have       *
*           unmounted it (unassigned drive letter in Windows, umount in UNIX/LINUX).  *
*                                                                                     *
*           As a formatting disk is going to appear dead to your operating system,    *
*           you may have to endure some error or system log messages, or even force   *
*           the system to rediscover devices after the process has formatting has     *
*           been completed.  WARNING:  If the formatting is interrupted due to        *
*           a power failure or an external hardware/software problem, then you must   *
*           reformat the disk as this is the only way to recover from an incomplete   *
*           format.                                                                   *
*                                                                                     *
*           If you are formatting a disk as part of a disk drive firmware update and  *
*           drive cloning procedure, don't forget to also clone the mode pages        *
*           BEFORE reformatting, as the disk topology (sector sizes) and defect       *
*           layout are defined in the mode pages and used by the disk as part of      *
*           the formatting process.                                                   *
*******************************************************************************

This will format the SEAGATE ST336605FC disk at \\.\SCSI2Port2Path0Target19Lun0
Do you want to clear the grown defects (GLIST) as the disk is formatted? <Y/N>: N
```

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```
Do you want to assign a custom (non-zero) defect list format or assign vendor-unique settings? <Y/N>: N
Are you sure you want to do this? Answer "YES" to begin the low-level format, anything else exits program:
YES

Sending command .... This will be last text you see until format complete or rejected.
Formatting ... [This is where the cursor will stay until format complete] completed ... Program terminating.
```

Command Options

Once you see the warning message after you invoke this command, you will be given the opportunity to select some additional features which must be defined before the format command is sent to the disk drive. The reason is these additional functions can only be performed on a disk at the time you format it. This is not a SMARTMonUX limitation. These constraints are within the ANSI SCSI specification.

Do not combine the **`-format`** *command with any other options. As this feature is destructive, it may not be run in batch mode, and requires you to enter YES before the program begins reformatting your disk drive.*

You may add the **`-confirm`** *command which will suppress the are-you-sure. We strongly recommend you only use this in a batch test environment where you know exactly what you are doing. You will not be able to stop the process once you press return.*

Clear Grown Defects

Disks typically (but not always) maintain a list of factory (called primary defects, or PLIST) and grown defects, called the GLIST. There may also be a DLIST. The primary defect list is created at time of manufacture and cannot be altered. The GLIST is built after time of manufacture and grow as either the disk detects areas as data is written, or the operating system detects a problem with an area of the disk and reassigns the data to another location.

SMARTMonUX allows you to clear the grown defect list at the time you format the disk, or more correctly, allows you to turn on this feature that is inherent in the disk drive, when the SCSI command to reformat is sent to the disk. Ordinarily you would rarely want to clear the grown defects, as they are built over time whenever the disk detects a bad area of the disk and decides data should not be kept there. If you clear the defect list then you run risk of data loss when data is written to a bad sector that is not marked as bad. We will not editorialize further on the merits of clearing the GLIST and suggest you contact your storage vendor to determine whether clearing the GLIST is something you need to do. We will say that the only time we ever clear the defect list is when we reformat the disk to use a different sector size, and we follow the operation with a program that fully exercises every sector in the disk to properly rebuild the GLIST before any live data is put on the drive.

Specifying the Defect List Format

The ANSI specification allows for numerous formats that the defect lists can be presented to a program when it sends the appropriate SCSI commands to retrieve the data. Basically you have vendor unique, bytes-from-index, and physical sector format. Ordinarily you would take the defaults, format 0, which is mandatory per the ANSI spec for all disk drives. This might not be the correct format for drives that have special OEM firmware on them or are placed behind some RAID controllers. If you do not know what format to use, ask your storage vendor.

Formatting Disk with Full Parameter Control

SMARTMonUX provides the user a mechanism to specify the complete SCSI CDB. This allows you to do anything from force a certain interleave factor to provide custom defect layouts or even pass vendor/drive unique commands to the disk to perform tasks that are only documented under customer/vendor non-disclosure agreements. If you need to format your disk with non-standard parameters, answer Y to the "*`Do you want to assign a custom (non-zero) defect list format or assign vendor-unique settings`*" question. You would then see:

```
Do you want to assign a custom (non-zero) defect list format or assign vendor-unique settings? <Y/N>: y
Please enter the last 5 bytes of the FORMAT UNIT CDB in hex. If you don't know what they
should be, then it is highly probable you should NOT be sending vendor-unique info.
CDB[0] = 04
CDB[1] =
```

You would enter the hex byte for the 2nd CDB byte and continue the process until all 6 bytes of the SCSI CDB were filled in. The reason the first byte of the CDB is 04 is because that value represents the op-code to perform the FORMAT UNIT command, so that would not change. After all 6 bytes have been entered (red represents what the computer displays, blue is what the user typed in this example), the format would begin provided you entered YES

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after entering the rest of the command. In the example below, we instructed the drive to clear the GLIST, use defect format #4, and set the interleave factor to 2. To repeat an earlier warning, if you do not know what all of this means, you should probably not be doing this. We strongly recommend contacting your storage vendor to determine whether or not a special format command should be sent rather than the default.

```
Do you want to assign a custom (non-zero) defect list format or assign vendor-unique settings? <Y/N>: y
Please enter the last 5 bytes of the FORMAT UNIT CDB in hex. If you don't know what they
should be, then it is highly probable you should NOT be sending vendor-unique info.
CDB[0] = 04
CDB[1] = 0B
CDB[2] = 00
CDB[3] = 00
CDB[4] = 02
CDB[5] = 00

Will send CDB = 04 0B 00 00 02 00
Are you sure you want to do this? Answer "YES" to begin the low-level format, anything else exits program:
NO

Low level formatting aborted. Program exiting now!
```

Formatting Disks in the Background

If your disks were made after 2005, then chances are good that they support background formatting. This command, **`-formatb`**, lets you issue the format command to a device and the selected disk formats in the background. The net result to the user is that the program returns immediately. If you combine the **`-formatb`** with the **`-confirm`** command, then you can format dozens or hundreds of disk drives at once, with no host computer overhead. Background formatting makes a lot of sense if you have (JBOD) enclosures and a large number of disks that need to be reformatted.

```
C:\>smartmon-ux -formatb \\.\PHYSICALDRIVE4
SMARTMon-UX [Release 1.42, Build 17-NOV-2009] - Copyright 2001-2009 SANtools(R), Inc.
http://www.SANtools.com
Discovered HITACHI HUS103073FLF210 S/N "V3W908XA0055P6591CC9" on \\.\PHYSICALDRIVE4 [SES] (SMART enabled)
[Bus/Port/ID.LUN=1/2/2.0](694
60 MB)

********************************************************************************
* Warning:  You have instructed the software to reformat the selected disk. No checks *
*           will be made to verify that the disk isn't mounted or in use in any way.  *
*           (Although reformatting your boot disk will blow the O/S, it will work.)   *
*                                                                              *
*           The process could take several hours to complete, and this program will   *
*           lock up until either the formatting is complete or the drive rejects the  *
*           command.  Once the command is sent to the device, the software will       *
*           suspend and wait for the action to complete.                       *
*                                                                              *
*           Your operating system may attempt to query the disk unless you have       *
*           unmounted it (unassigned drive letter in Windows, umount in UNIX/LINUX).  *
*                                                                              *
*           As a formatting disk is going to appear dead to your operating system,    *
*           you may have to endure some error or system log messages, or even force   *
*           the system to rediscover devices after the process has formatting has     *
*           been completed.  WARNING:  If the formatting is interrupted due to        *
*           a power failure or an external hardware/software problem, then you must   *
*           reformat the disk as this is the only way to recover from an incomplete   *
*           format.                                                            *
*                                                                              *
*           If you are formatting a disk as part of a disk drive firmware update and  *
*           drive cloning procedure, don't forget to also clone the mode pages        *
*           BEFORE reformatting, as the disk topology (sector sizes) and defect       *
*           layout are defined in the mode pages and used by the disk as part of      *
*           the formatting process.                                            *
********************************************************************************

This will format the HITACHI HUS103073FLF210 disk at \\.\PHYSICALDRIVE4
Do you want to clear the grown defects (GLIST) as the disk is formatted? <Y/N>: y
Do you want to assign a custom (non-zero) defect list format or assign vendor-unique settings? <Y/N>: N
Are you sure you want to do this? Answer "YES" to begin the low-level format, anything else exits program:
```

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```
YES

Sending command ... Background format acknowledged and running.
 Program terminating.
```

You may use the **-str** command, which reports status of self-tests to see if the selected disk has completed the operation.

```
C:\>smartmon-ux -str \\.\PHYSICALDRIVE4
SMARTMon-UX [Release 1.42, Build 17-NOV-2009] - Copyright 2001-2009 SANtools(R), Inc.
http://www.SANtools.com
Discovered HITACHI HUS103073FLF210 S/N "V3W908XA0055P6591CC9" on \\.\PHYSICALDRIVE4 [SES] (SMART
unsupported) [Bus/Port/ID.LUN=1/2/2.0]

 - Results from last self-test: Logical unit not ready, format in progress

Program Ended.
```

1.18 Inquiry Page Viewer

The inquiry page data, which can be obtained by sending the **-I** or **-I+** options, contains valuable information about the selected device. This contains everything from make and model of peripheral to more exotic information such the serial number, or maybe even where and when it was made.

The ANSI specification requires that all SCSI devices (remember SCSI includes fibre channel, SSA, and Fire Wire) have a standard inquiry page. This is the information that your operating system looks at when determining what it is hooked up to, and how it needs to communicate with it.

You can download the various ANSI specification files from http://www.t10. The documents have full information about interpreting the hundreds of bytes, bits, and bit fields found in SCSI family peripherals. In the interest of enticing you to download the spec, we will discuss a small subset of the information we are learning about one of the Seagate disk drives attached to a development system.

Please refer to this page of the specification. It shows the type of information contained in the first 36 bytes of a standard Inquiry. Note that this dump is specific to just one of many SCSI variants depending on what level of the ANSI specification your particular device supports. Various bits and bytes are first undefined, may be defined, retired (become obsolete), or changed to reflect different data depending on what level of the specification your particular device was designed to report.

Notice also that the number of defects are also reported as of release 1.20. This information is not part of a standard SCSI inquiry, but it seemed like the logical place to put this type of information.

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9 March 2002 T10/1416-D Revision 05

7.4.2 Standard INQUIRY data

The standard INQUIRY data (see table 56) shall contain at least 36 bytes.

Table 56 — Standard INQUIRY data format

Bit / Byte	7	6	5	4	3	2	1	0
0	PERIPHERAL QUALIFIER			PERIPHERAL DEVICE TYPE				
1	RMB	Reserved						
2	VERSION							
3	AERC	Obsolete	NORMACA	HISUP	RESPONSE DATA FORMAT			
4	ADDITIONAL LENGTH (n-4)							
5	SCCS	ACC	ALUA		3PC	Reserved		
6	BQUE	ENCSERV	VS	MULTIP	MCHNGR	Obsolete	Obsolete	ADDR16[a]
7	RELADR	Obsolete	WBUS16[a]	SYNC[a]	LINKED	Obsolete	CMDQUE	VS
8	(MSB)	VENDOR IDENTIFICATION						
15								(LSB)
16	(MSB)	PRODUCT IDENTIFICATION						
31								(LSB)
32	(MSB)	PRODUCT REVISION LEVEL						
35								(LSB)
36	Vendor specific							
55								

In order to obtain this information, use the **-I** or **-I+** options ...

```
# ./smartmon-ux -I+ /dev/sg0 /dev/st[0-1]
SMARTMon-UX [Release 1.35, Build 18-JAN-2008] - Copyright 2001-2008 SANtools(R), Inc. http://www.SANtools.
com
Discovered SEAGATE ST373307LC S/N "3HZ06HS8" on /dev/sg0 (SMART enabled)(70007 MB)
 Inquiry Text Page Data - ANSI defined fields
   Device Type:                          disk
   Peripheral Qualifier:                 Connected to this LUN
   Removable Device:                     NO
   ANSI Version:                         3 (SPC ANSI X3.301:1997)
   Vendor Identification:                SEAGATE
   Product Identification:               ST373307LC
   Firmware Revision:                    0006
   Async event reporting: (AERC)         NO
   Terminate task supported:             NO
   Response data format:                 2
   Relative addressing supported:        NO
   Supports request/ACK data transfer:   NO
   Normal ACA Supported:                 NO
   Enclosure services available:         NO
   Multi-ported device:                  NO
   Medium-changer attached: (removable)  NO
   Linked commands supported:            YES
   Command queuing supported:            YES
   VS bit (byte #6/bit #5 set):          NO
   VS bit (byte #7/bit #0 set):          NO
   Total Capacity (In Bytes):            73407868928
   Total grown defects:                  0
   Total Primary (factory) defects:      465
```

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```
  Board serial number:                80000231343EA
  Servo RAM Release number:           2002C907
  Servo ROM Release number:           00000000
  Servo RAM Release date:             C907
  Servo ROM Release date:             2002
  ETF Log date MMDDYYYY:              10/06/2002
  Compile date code MMDDYYYY:         05/16/2003
  Jumpers DS MS WP PE D0 D1 D2 D3:    10000000b
  Drive behavior version number:      3
  Drive behavior code:                7
  Drive behavior code version:        0
  Family number:                      ST373307LC
  Maximum interleave:                 3
  Default # of cache segments:        32
Inquiry Page Hex Dump:
  0000: 00 00 03 12 8B 00 01 3E 53 45 41 47 41 54 45 20    .......>SEAGATE
  0010: 53 54 33 37 33 33 30 37 4C 43 20 20 20 20 20 20    ST373307LC
  0020: 30 30 30 36 33 48 5A 30 36 48 53 38 00 00 00 00    00063HZ06HS8....
  0030: 00 00 00 00 00 00 00 00 0F 00 00 00 00 00 00 00    ................
  0040: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  0050: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  0060: 00 43 6F 70 79 72 69 67 68 74 20 28 63 29 20 32    .Copyright (c) 2
  0070: 30 30 33 20 53 65 61 67 61 74 65 20 41 6C 6C 20    003 Seagate All
  0080: 72 69 67 68 74 73 20 72 65 73 65 72 76 65 64       rights reserved
 Inquiry EVPD Page #80h (Serial Number Page)
  0000: 00 80 00 14 33 48 5A 30 36 48 53 38 30 30 30 30    ....3HZ06HS80000
  0010: 32 33 31 33 34 33 45 41                            231343EA
 Inquiry EVPD Page #81h
  0000: 00 81 00 03 04 84 84                               .......
 Inquiry EVPD Page #C0h
  0000: 00 C0 00 38 30 35 31 36 30 30 30 36 32 30 30 32    ...8051600062002
  0010: 43 39 30 37 30 30 30 30 30 30 30 43 39 30 37       C907000000000C907
  0020: 32 30 30 32 32 30 30 32 43 39 30 37 43 39 30 37    20022002C907C907
  0030: 32 30 30 32 30 30 30 30 31 39 30 32                200200001902
 Inquiry EVPD Page #C1h
  0000: 00 C1 00 10 31 30 30 36 32 30 30 32 30 35 31 36    ....100620020516
  0010: 32 30 30 33                                        2003
 Inquiry EVPD Page #C2h
  0000: 00 C2 00 02 80 00                                  ......
 Inquiry EVPD Page #C3h
  0000: 00 C3 00 F6 03 07 00 53 54 33 37 33 33 30 37 4C    .......ST373307L
  0010: 43 20 20 20 20 20 20 03 20 00 01 AE 96 C0 00 00    C      . .......
  0020: B8 38 49 18 00 02 CA 10 C0 00 00 40 16 01 00 00    .8I........@....
  0030: 02 C0 40 06 B6 68 06 06 6C 82 00 24 00 24 A0 40    ..@..h..l..$.$.@
  0040: 03 03 08 19 00 00 00 03 0F 05 D0 00 00 00 00 00    ................
  0050: E0 00 00 80 00 00 00 00 00 00 00 00 00 00 00 00    ................
  0060: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  0070: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  0080: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  0090: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  00a0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  00b0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  00c0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  00d0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  00e0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  00f0: 00 00 00 00 00 00 00 00 00 00                      ..........
 Inquiry EVPD Page #D1h
  0000: 00 D1 00 F0 39 56 33 30 30 36 2D 30 30 32 20 20    ....9V3006-002
  0010: 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
  0020: 20 20 20 20 43 43 47 54 30 33 31 33 33 31 20 20        CCGT031331
  0030: 20 20 20 20 30 33 31 31 31 43 20 20 20 20 20 20        03111C
  0040: 20 20 20 20 35 33 30 37 30 34 45 45 4E 31 32 33        530704EEN123
  0050: 42 43 20 31 30 30 31 39 39 34 34 33 41 20 20 20    BC 100199443A
  0060: 20 20 20 20 54 33 30 38 50 58 45 38 4F 30 20 20        T308PXE8O0
  0070: 20 20 20 20 54 33 30 38 50 58 45 38 4F 30 20 20        T308PXE8O0
  0080: 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
  0090: 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
  00a0: 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
  00b0: 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
  00c0: 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
  00d0: 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
```

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```
   00e0: 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
   00f0: 20 20 20 20
  Inquiry EVPD Page #D2h
   0000: 00 D2 00 F0 32 30 30 32 43 39 30 37 20 20 20 20    ....2002C907
   0010: 20 20 20 20 30 35 31 36 30 30 30 36 20 20 20 20        05160006
   0020: 20 20 20 20 31 30 30 32 33 30 35 39 39 20 20 20        100230599
   0030: 20 20 20 20 47 20 20 20 20 20 20 20 20 20 20 20        G
   0040: 20 20 20 20 32 33 31 33 34 33 45 41 20 20 20 20        231343EA
   0050: 20 20 20 20 33 31 33 20 20 20 20 20 20 20 20 20        313
   0060: 20 20 20 20 30 30 32 33 20 20 20 20 20 20 20 20        0023
   0070: 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
   0080: 20 20 20 20 30 30 32 33 31 33 20 20 55 35 20 32        002313  U5 2
   0090: 39 32 30 20 31 20 20 20 20 20 20 20 20 20 20 20    920 1
   00a0: 20 20 20 20 30 32 33 20 20 20 36 20 20 20 20 20        023   6
   00b0: 32 39 37 37 33 32 35 30 30 30 20 55 32 30 30 4D    2977325000 U200M
   00c0: 36 39 30 20 35 20 20 20 20 20 20 20 20 20 20 20    690 5
   00d0: 20 20 20 20 30 32 33 20 20 20 31 20 20 20 20 20        023   1
   00e0: 20 20 54 32 20 20 20 20 20 20 20 20 20 20 20 20      T2
   00f0: 20 20 20 20

Discovered SONY SDT-5200 S/N " " on /dev/st0 (tape)
 Inquiry Text Page Data - ANSI defined fields
   Device Type:                          tape
   Peripheral Qualifier:                 Connected to this LUN
   Removable Device:                     YES
   ANSI Version:                         2 (SCSI-2 ANSI X3.131:1994)
   ISO/IEC Version:                      0
   ECMA Version:                         0
   Vendor Identification:                SONY
   Product Identification:               SDT-5200
   Firmware Revision:                    3.30
   Terminate task supported:             NO
   Response data format:                 2
   Relative addressing supported:        NO
   Supports request/ACK data transfer:   NO
   32-bit parallel supported:            NO
   16-bit parallel supported:            NO
   Synchronous commands supported:       YES
   Linked commands supported:            YES
   Command queuing supported:            NO
   SAF-TE Enclosure services available: NO
  Inquiry Page Hex Dump:
   0000: 01 80 02 02 1F 00 00 18 53 4F 4E 59 20 20 20 20    ........SONY
   0010: 53 44 54 2D 35 32 30 30 20 20 20 20 20 20 20 20    SDT-5200
   0020: 33 2E 33                                           3.3

Discovered TANDBERG SLR7 S/N "SN007005396" on /dev/st1 (tape)
 Inquiry Text Page Data - ANSI defined fields
   Device Type:                          tape
   Peripheral Qualifier:                 Connected to this LUN
   Removable Device:                     YES
   ANSI Version:                         2 (SCSI-2 ANSI X3.131:1994)
   ISO/IEC Version:                      0
   ECMA Version:                         0
   Vendor Identification:                TANDBERG
   Product Identification:               SLR7
   Firmware Revision:                    0483
   Async event reporting: (AERC)         NO
   Supports 16-bit wide addresses:       YES
   Supports 32-bit wide addresses:       NO
   Supports ACKQ/REQQ handshaking:       NO
   Terminate task supported:             NO
   Response data format:                 2
   Relative addressing supported:        NO
   Supports request/ACK data transfer:   NO
   Normal ACA Supported:                 NO
   32-bit parallel supported:            NO
   16-bit parallel supported:            YES
   Synchronous commands supported:       YES
   Linked commands supported:            YES
   Command queuing supported:            NO
```

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```
 SAF-TE Enclosure services available: NO
 VS bit (byte #6/bit #5 set):         NO
 VS bit (byte #7/bit #0 set):         NO
 Capstan motor assembly rev:           L
 Step motor assembly rev:              C
 Cartridge manipulation motor rev:     0
 Sensor assembly rev:                  A
 Mainboard assembly rev:               D
 Frame module rev:                     2
 Head assembly rev:                    0
 Top cover rev:                        0
 Bridge module rev:                    0
 Main spring module rev:               1
 Main microcode rev:                 0483
 Main microcode release status:      D
 Main microcode branch rev:          0000
 Main microcode ID:                  =
 DSP microcode rev level:            0483
 DSP microcode release status:       ..
 Drive manufacturing MM.DD.YY:       06.12.01
 Main microcode creation MM.DD.YY:   07.03.01
 DSP microcode creation MM.DD.YY:    07.03.01
 Last drive adjustment MM.DD.YY:     ........
Inquiry Page Hex Dump:
 0000: 01 80 02 02 2B 00 01 38 54 41 4E 44 42 45 52 47    ....+..8TANDBERG
 0010: 53 4C 52 37 20 20 20 20 20 20 20 20 20 20 20 20    SLR7
 0020: 30 34 38 33 44 30 30 30 30 3D 20 30 34 38 33       0483D0000= 0483
Inquiry EVPD Page #80h (Serial Number Page)
 0000: 01 80 00 0C 53 4E 30 30 37 30 30 35 33 39 36 00    ....SN007005396.
Inquiry EVPD Page #81h
 0000: 01 81 00 02 03 03                                  ......
Inquiry EVPD Page #82h (Operating Definition Page)
 0000: 01 82 00 14 13 53 43 53 49 2D 32 20 58 33 2E 31    .....SCSI-2 X3.1
 0010: 33 31 2D 31 39 39 34 00                            31-1994.
Inquiry EVPD Page #C0h
 0000: 01 C0 00 17 20 4C 20 43 20 30 20 41 20 44 20 32    .À.. L C 0 A D 2
 0010: 20 30 20 30 20 30 20 31 20 32 00                    0 0 0 1 2.
Inquiry EVPD Page #C1h
 0000: 01 C1 00 11 30 34 38 33 44 30 30 30 30 3D 20 30    .Á..0483D0000= 0
 0010: 34 38 33 44 00                                     483D.
Inquiry EVPD Page #C2h
 0000: 01 C2 00 09 30 36 2E 31 32 2E 30 31 00             .Â..06.12.01.
Inquiry EVPD Page #C3h
 0000: 01 C3 00 12 30 37 2E 30 33 2E 30 31 2F 30 37 2E    .Ã..07.03.01/07.
 0010: 30 33 2E 30 31 00                                  03.01.
Inquiry EVPD Page #C4h
 0000: 01 C4 00 09 FF FF FF FF FF FF FF FF 00             .Ä..ÿÿÿÿÿÿÿÿ.
```

As you can see, the Seagate disk drive and the Tandberg tape drive have a lot of information to report. You can get part and serial numbers for individual drive components, firmware revisions, world-wide-name, and hundreds of other fields. You should also be aware that many fields are vendor-specific. This means their record layouts are not standardized by the ANSI committee, so you will need to contact Seagate to obtain this information. Please contact your manufacturer to obtain the layouts, and/or view their web sites. All of this information is usually online.

If you had just entered the **-I** option, you would have gotten same results, without the EVPD page hex dumps, and without the fields which appear after the defects. In the dump above, the fields in **blue** will only be reported with the **-I+** command as they come from the EVPD pages.

Fibre Channel disk drives will also report the World Wide Name (also called the IEEE Device ID). If the above disk was a fibre channel disk, then a line such as the one below would be added to the report under Board Serial Number. This was added in release 1.30.

```
 IEEE Unique ID:         20-00-00-11-C6-B5-64-45
```

Additionally, if you have an IDE disk drive and are running a distribution that supports IDE drives, you might see similar results from supplying the -I+ option:
The output below is from an SATA (ATA-7 type) drive. Each version of the ATA specification has some fields which have either been added or deleted from previous versions. In addition, some fields are specific to serial ATA (SATA)

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disks or parallel ATA disks (PATA), so do not expect all of these fields to be applicable to your particular type of disk drive.

```
SMARTMon-ux [Release 1.23, Build 07-DEC-2003] - Copyright 2003 SANtools, Inc. http://www.SANtools.com
Discovered Maxtor 6Y080M0 S/N "Y3JRAGXE" on /dev/hda (SMART Enabled)
 Inquiry Text Page Data - ATA defined fields
   Device Type:                          Fixed Disk
   Model Number:                         Maxtor 6Y080M0
   Serial Number:                        Y3JRAGXE
   Interface:                            ATA/ATAPI-7 T13 1532D revision 0
   Firmware Revision:                    YAR51BW0
   Usable addressable sectors LBA mode: 3120564618
   IORDY Supported:                      YES
   IORDY can be disabled:                YES
   LBA Supported:                        YES
   DMA Supported:                        YES
   Standby timer values supported:       YES
   Download microcode supported:         YES
   Read/write DMA queue code supported: NO
   CFA feature set supported:            NO
   Advanced power management supported: YES
   Removable media status notification: NO
   Power-up in standby supported:        NO
   SET FEATURES command required:        NO
   SET MAX security feature supported:   YES
   Automatic acoustic mgmt supported:    YES
   48-bit addressing supported:          NO
   Device configuration overlay:         YES
   Mandatory FLUSH CACHE supported:      YES
   FLUSH CACHE EXT command:              YES
   Security features supported:          YES
   Drive security status:                Maximum
   Enhanced security erase:              Maximum
   Security count expired:               NO
   Security is frozen:                   YES
   Security is locked:                   NO
   Security is enabled:                  NO
   Security level:                       High
   S.M.A.R.T. feature set supported:     YES
   Security mode feature set supported: YES
   Removable media supported:            NO
   Power management supported:           YES
   Packet command feature supported:     NO
   Write cache supported:                YES
   Look-ahead supported:                 YES
   Release interrupt supported:          NO
   Service interrupt supported:          NO
   Device reset command supported:       NO
   Host protected area feature set:      YES
   Write buffer command supported:       YES
   Read buffer command supported:        YES
   NOP command supported:                YES
   S.M.A.R.T. error logging supported:   YES
   S.M.A.R.T. self-test supported:       YES
   Media serial number supported:        NO
   Media card pass through supported:    NO
   Streaming feature set supported:      NO
   General purpose logging feature:      NO
   Write DMA FUA EXT feature set:        NO
   Write DMA QUEUED FUA EXT feature:     NO
   Current Ultra DMA mode:               2
   Highest Ultra DMA mode supported:     6
   Highest Multiword DMA mode supportd: 2
   Max sectors for RW multiple command: 16
   Current sectors for RW multiple:      16
   Highest PIO mode supported:           4
   Min MW DMA xfer cycle time/word(ns): 120
   Manuf. recommended MW DMA xfer (ns): 120
   Min PIO xfer cycle w/o flow(ns):      120
   Min PIO xfer cycle time w/IORDY(ns): 120
```

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```
   Time required for security erase:    unspecified
   Time required for enh security erase: unspecified
   Master password revision code:       65534
   Current auto acoustic mgmt. value:   254
   Rec. auto acoustic mgmt. value:      192
   Service interrupt enabled:           NO
   Release interrupt enabled:           NO
   Look-ahead enabled:                  YES
   Write cache enabled:                 YES
   Security mode feature enabled:       NO
   S.M.A.R.T. feature set enabled:      YES
   Advanced power management enabled:   NO
   Removable media notif. enabled:      NO
   Max LBA in 48-bit address mode:      0
   Total bytes in 48-bit address mode:  0
   Supports SATA Gen-1 sig speed:       NO
   Supports SATA Gen-2 sig speed:       NO
   Supports SATA native command queues: NO
   Supports SATA host-init power mgmt:  NO
   Offline collection status:           128 (Never started)
   Self-test execution status:          0 (Completed w/o error)
   Offline data collection supported:   YES
   Offline data collection requires:    182 seconds
   S.M.A.R.T. offline diags supported:  YES
   S.M.A.R.T. vendor-specific testing:  YES
   S.M.A.R.T. offline diags restarting: NO
   S.M.A.R.T. offline read scanning:    YES
   S.M.A.R.T. offline self-tests:       YES
   S.M.A.R.T. power-mode saving:        YES
   S.M.A.R.T. autosave after event:     YES
   Min. short self-test polling time:   2 minutes
   Min. extnded self-test polling time: 40 minutes
 Inquiry page dump below:
  0000: 40 00 FF 3F 37 C8 10 00 00 00 00 00 3F 00 00 00    @..?7.......?...
  0010: 00 00 00 00 59 33 4A 52 41 47 58 45 00 00 00 00    ....Y3JRAGXE....
  0020: 00 00 00 00 00 00 00 00 03 00 00 3E 04 00 59 41    ...........>..YA
  0030: 52 35 31 42 57 30 4D 61 78 74 6F 72 20 36 59 30    R51BW0Maxtor 6Y0
  0040: 38 30 4D 30 00 00 00 00 00 00 00 00 00 00 00 00    80M0............
  0050: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 10 80    ................
  0060: 00 00 00 2F 00 40 00 02 00 00 07 00 FF 3F 10 00    .../.@.......?..
  0070: 3F 00 10 FC FB 00 10 01 00 BA 8A 09 00 00 07 00    ?...............
  0080: 03 00 78 00 78 00 78 00 78 00 00 00 00 00 00 00    ..x.x.x.x.......
  0090: 00 00 00 00 00 00 00 00 01 00 00 00 00 00 00 00    ................
  00a0: FE 00 1E 00 6B 7C 09 7B 03 40 69 7C 01 3A 03 40    ....k|.{.@i|.:.@
  00b0: 7F 04 00 00 00 00 00 00 FE FF 00 00 FE C0 00 00    ................
  00c0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  00d0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  00e0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  00f0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  0100: 09 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  0110: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  0120: 00 00 00 00 00 00 00 00 00 00 00 00 17 00 40 20    ..............@
  0130: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  0140: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  0150: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  0160: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  0170: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  0180: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  0190: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  01a0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  01b0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  01c0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  01d0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  01e0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  01f0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 A5 F7    ................

Program Ended.
```

IDE device information and specifics of what all of this means can be found at the **http://www.t13.org** web site.

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1.18.1 Example Inquiry Dump - SAS Disk

The results below were run under SPARC Solaris 10 using a Seagate ST3146855SS SAS disk.

```
# /etc/smartmon-ux -I+ /dev/rdsk/c4t17d0s0
SMARTMon-UX [Release 1.36, Build  8-JUN-2008] - Copyright 2001-2008 SANtools(R), Inc. http://www.SANtools.
com
Discovered SEAGATE ST3146855SS S/N "3LN29QG4" on /dev/rdsk/c4t17d0s0 (SMART enabled)(140014 MB)
 Inquiry Text Page Data - ANSI defined fields
   Device Type:                          disk
   Peripheral Qualifier:                 Connected to this LUN
   Removable Device:                     NO
   ANSI Version:                         5 (SPC-3 ANSI)
   Vendor Identification:                SEAGATE
   Product Identification:               ST3146855SS
   Firmware Revision:                    MS01
   Async event reporting: (AERC)         NO
   Response data format:                 2
   Relative addressing supported:        NO
   Supports request/ACK data transfer:   NO
   Normal ACA Supported:                 NO
   Enclosure services available:         NO
   Multi-ported device:                  YES
   Medium-changer attached: (removable)  NO
   Linked commands supported:            YES
   Command queuing supported:            YES
   Basic Queuing supported (BQue):       NO
   Hierarchical support (HiSUP):         YES
   Embedded storage array controller:    NO
   Access controls coordinator:          NO
   Asymmetric logical unit access:       Not supported or vendor-specific
   Third-party copy supported:           NO
   VS bit (byte #6/bit #5 set):          NO
   VS bit (byte #7/bit #0 set):          NO
   Total Capacity (In Bytes):            146815737856
   Total grown defects:                  0
   Total Primary (factory) defects:      5314
   Board serial number:                  400009811QJMY
   Servo RAM Release number:             2006C395
   Servo ROM Release number:             00000000
   Servo RAM Release date:               C395
   Servo ROM Release date:               2006
   ETF Log date MMDDYYYY:                09/15/2007
   Compile date code MMDDYYYY:           11/17/2006
   Jumpers DS MS WP PE D0 D1 D2 D3:      00000000b
   Drive behavior version number:        4
   Drive behavior code:                  16
   Drive behavior code version:          0
   Family number:                        ST3146855SS
   Maximum interleave:                   1
   Default # of cache segments:          32
   IEEE Unique ID:                       50-00-C5-00-06-94-BF-FF
   NAA IEEE ID:                          50-00-C5-00-06-94-BF-FD
 Inquiry Page Hex Dump:
   0000: 00 00 05 12 8B 00 10 0A 53 45 41 47 41 54 45 20    ........SEAGATE
   0010: 53 54 33 31 34 36 38 35 35 53 53 20 20 20 20 20    ST3146855SS
   0020: 4D 53 30 31 33 4C 4E 32 39 51 47 34 00 00 00 00    MS013LN29QG4....
   0030: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
   0040: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
   0050: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
   0060: 00 43 6F 70 79 72 69 67 68 74 20 28 63 29 20 32    .Copyright (c) 2
   0070: 30 30 36 20 53 65 61 67 61 74 65 20 41 6C 6C 20    006 Seagate All
   0080: 72 69 67 68 74 73 20 72 65 73 65 72 76 65 64       rights reserved
  Inquiry EVPD Page #80h (Serial Number Page)
   0000: 00 80 00 14 33 4C 4E 32 39 51 47 34 30 30 30 30    ....3LN29QG40000
   0010: 39 38 31 31 51 4A 4D 59                            9811QJMY
  Inquiry EVPD Page #82h (Operating Definition Page)
   0000: 00 82 00 1D 1C 54 31 30 2F 31 34 31 36 2D 44 20    .....T10/1416-D
   0010: 52 65 76 69 73 69 6F 6E 20 37 20 20 20 20 20 20    Revision 7
   0020: 00                                                 .
  Inquiry EVPD Page #83h (Device Identification Page)
   0000: 00 83 00 48 01 03 00 08 50 00 C5 00 06 94 BF FF    ...H....P.......
```

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```
  0010: 61 93 00 08 50 00 C5 00 06 94 BF FD 61 94 00 04    a...P.......a...
  0020: 00 00 00 01 61 A3 00 08 50 00 C5 00 06 94 BF FC    ....a...P.......
  0030: 63 A8 00 18 6E 61 61 2E 35 30 30 30 43 35 30 30    c...naa.5000C500
  0040: 30 36 39 34 42 46 46 43 00 00 00 00                0694BFFC....
 Inquiry EVPD Page #C0h
  0000: 00 C0 00 38 31 31 31 37 43 41 30 31 32 30 30 36    ...81117CA012006
  0010: 43 33 39 35 30 30 30 30 30 30 30 30 43 33 39 35    C39500000000C395
  0020: 32 30 30 36 32 30 30 36 43 34 39 32 43 34 39 32    20062006C492C492
  0030: 32 30 30 36 30 30 30 30 32 31 30 32                200600002102
 Inquiry EVPD Page #C1h
  0000: 00 C1 00 10 30 39 31 35 32 30 30 37 31 31 31 37    ....091520071117
  0010: 32 30 30 36                                        2006
 Inquiry EVPD Page #C2h
  0000: 00 C2 00 02 00 00                                  ......
 Inquiry EVPD Page #C3h
  0000: 00 C3 00 F6 04 10 00 53 54 33 31 34 36 38 35 35    .......ST3146855
  0010: 53 53 20 20 20 20 20 01 20 FF 00 97 00 80 11 71    SS     . ......q
  0020: 00 00 00 00 FF 00 03 0F 05 57 00 00 00 00 00 00    .........W......
  0030: 00 00 00 00 00 00 00 00 00 80 00 62 00 00 00 A8    ...........b....
  0040: 80 08 02 00 00 E0 00 00 80 00 08 50 C0 00 00 E0    ...........P....
  0050: 00 00 00 80 00 00 00 00 00 00 0D 00 00 00 00 00    ................
  0060: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  0070: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  0080: 00 00 00 01 00 00 17 17 00 00 15 5F 08 00 07 FC    ............_....
  0090: 0E 00 00 41 04 4C 28 28 14 12 14 0B 05 0B 0B 00    ...A.L((........
  00a0: F0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  00b0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  00c0: 80 C0 09 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  00d0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  00e0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  00f0: 00 00 00 00 00 00 00 00 00 00                      ..........
 Inquiry EVPD Page #D1h
  0000: 00 D1 00 F0 39 5A 32 30 36 36 2D 30 34 33 20 20    ....9Z2066-043
  0010: 20 20 20 20 31 30 30 34 34 34 33 31 37 20 20 20        100444317
  0020: 20 20 20 20 45 45 38 30 39 35 48 38 42 4D 20 20        EE8095H8BM
  0030: 20 20 20 20 34 36 31 37 30 34 36 43 4D 34 31 30        4617046CM410
  0040: 38 30 30 30 45 38 30 39 35 48 38 42 4D 31 30 31    8000E8095H8BM101
  0050: 41 44 42 31 30 30 34 35 31 30 34 32 41 20 20 20    ADB100451042A
  0060: 20 20 20 20 31 30 30 33 37 38 31 39 35 20 20 20        100378195
  0070: 20 20 20 20 31 30 30 33 37 38 31 39 36 20 20 20        100378196
  0080: 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
  0090: 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
  00a0: 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
  00b0: 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
  00c0: 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
  00d0: 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
  00e0: 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
  00f0: 20 20 20 20
 Inquiry EVPD Page #D2h
  0000: 00 D2 00 F0 32 30 30 36 43 33 39 35 20 20 20 20    ....2006C395
  0010: 20 20 20 20 31 31 31 37 43 41 30 31 20 20 20 20        1117CA01
  0020: 20 20 20 20 31 30 30 34 32 37 33 39 36 20 20 20        100427396
  0030: 20 20 20 20 46 20 20 20 20 20 20 20 20 20 20 20        F
  0040: 20 20 20 20 39 38 31 31 51 4A 4D 59 20 20 20 20        9811QJMY
  0050: 20 20 20 20 38 31 31 20 20 20 20 20 20 20 20 20        811
  0060: 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
  0070: 20 20 20 20 33 4C 4E 32 39 51 47 34 30 30 30 30        3LN29QG40000
  0080: 39 38 31 31 20 20 20 20 20 20 20 20 20 20 20 20    9811
  0090: 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
  00a0: 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
  00b0: 20 20 20 20 30 30 4C 34 31 37 34 20 20 20 20 20        00L4174
  00c0: 54 30 37 20 33 32 20 20 20 20 20 20 20 20 20 20    T07 32
  00d0: 20 20 20 20 57 4D 4A 20 20 20 20 20 20 20 20 20        WMJ
  00e0: 20 20 20 20 30 30 4D 36 39 30 35 20 20 20 20 20        00M6905
  00f0: 20 30 37 20                                         07

Program Ended.
```

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1.18.2 Example Inquiry Dump - SCSI Tape

The results below were run under SPARC Solaris 10 using a Seagate ST3146855SS SAS disk.

```
# /etc/smartmon-ux -I+ /dev/rdsk/c4t17d0s0
SMARTMon-UX [Release 1.41, Build  1-NOV-2009] - Copyright 2001-2009 SANtools(R), Inc. http://www.SANtools.
com
Discovered TANDBERG SLR7 S/N "SN007005396" on \\.\TAPE0 (tape) [Bus/Port/ID.LUN=0/3/12.0]
 Inquiry Text Page Data - ANSI defined fields
   Device Type:                          tape
   Peripheral Qualifier:                 Connected to this LUN
   Removable Device:                     YES
   ANSI Version:                         2 (SCSI-2 ANSI X3.131:1994)
   ISO/IEC Version:                      0
   ECMA Version:                         0
   Vendor Identification:                TANDBERG
   Product Identification:               SLR7
   Firmware Revision:                    0595
   Async event reporting: (AERC)         NO
   Supports 16-bit wide addresses:       YES
   Supports 32-bit wide addresses:       NO
   Supports ACKQ/REQQ handshaking:       NO
   Terminate task supported:             NO
   Response data format:                 2
   Relative addressing supported:        NO
   Supports request/ACK data transfer:   NO
   Normal ACA Supported:                 NO
   32-bit parallel supported:            NO
   16-bit parallel supported:            YES
   Synchronous commands supported:       YES
   Linked commands supported:            YES
   Command queuing supported:            NO
   SAF-TE Enclosure services available:  NO
   VS bit (byte #6/bit #5 set):          NO
   VS bit (byte #7/bit #0 set):          NO
   Capstan motor assembly rev:            L
   Step motor assembly rev:               C
   Cartridge manipulation motor rev:      0
   Sensor assembly rev:                   A
   Mainboard assembly rev:                D
   Frame module rev:                      2
   Head assembly rev:                     0
   Top cover rev:                         0
   Bridge module rev:                     0
   Main spring module rev:                1
   Main microcode rev:                   0595
   Main microcode release status:        D
   Main microcode branch rev:            0000
   Main microcode ID:                    =
   DSP microcode rev level:              0595
   DSP microcode release status:         ..
   Drive manufacturing MM.DD.YY:         06.12.01
   Main microcode creation MM.DD.YY:     07.02.03
   DSP microcode creation MM.DD.YY:      07.02.03
   Last drive adjustment MM.DD.YY:       ........
 Inquiry Page Hex Dump:
   0000: 01 80 02 02 2B 00 01 38 54 41 4E 44 42 45 52 47    ....+..8TANDBERG
   0010: 53 4C 52 37 20 20 20 20 20 20 20 20 20 20 20 20    SLR7
   0020: 30 35 39 35 44 30 30 30 30 3D 20 30 35 39 35       0595D0000= 0595
  Inquiry EVPD Page #80h (Serial Number Page)
   0000: 01 80 00 0C 53 4E 30 30 37 30 30 35 33 39 36 00    ....SN007005396.
  Inquiry EVPD Page #81h
   0000: 01 81 00 02 03 03                                  ......
  Inquiry EVPD Page #82h (Operating Definition Page)
   0000: 01 82 00 14 13 53 43 53 49 2D 32 20 58 33 2E 31    .....SCSI-2 X3.1
   0010: 33 31 2D 31 39 39 34 00                            31-1994.
  Inquiry EVPD Page #C0h
   0000: 01 C0 00 17 20 4C 20 43 20 30 20 41 20 44 20 32    .... L C 0 A D 2
   0010: 20 30 20 30 20 30 20 31 20 32 00                    0 0 0 1 2.
  Inquiry EVPD Page #C1h
   0000: 01 C1 00 11 30 35 39 35 44 30 30 30 30 3D 20 30    ....0595D0000= 0
```

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```
  0010: 35 39 35 44 00                                    595D.
 Inquiry EVPD Page #C2h
  0000: 01 C2 00 09 30 36 2E 31 32 2E 30 31 00            ....06.12.01.
 Inquiry EVPD Page #C3h
  0000: 01 C3 00 12 30 37 2E 30 32 2E 30 33 2F 30 37 2E   ....07.02.03/07.
  0010: 30 32 2E 30 33 00                                 02.03.
 Inquiry EVPD Page #C4h
  0000: 01 C4 00 09 FF FF FF FF FF FF FF FF 00            .............

Program Ended.
```

1.19 International Localization

The **-i** option was added in release 1.24 to offer the user the ability to report date and time fields in localized format, that is, the format that is standard for your operating systems. Previous versions of the program selfishly reported dates and times in USA standard format.

For example, if your native language is French, a numeric date would be reported in DD-MM-YYYY format, rather than the MM-DD-YYYY format. Text dates would appear in French, rather than English as well.

The software determines your localization in what ever method is standard for your operating system. The non-Windows distributions look at the environment variable, **LC_ALL**, which is usually set up by the system administrator at O/S installation time. Windows-family operating systems allow the user to define the country and localization through the Control Panel -> Regional Options.

Note: The reason we added this new flag, rather than make localized date/time fields the default everywhere, was to protect users that might be using external scripts that utilize the date/time fields. This way, no end-user scripts will be broken. The exception is for fields that display once and are not polled, such as the login banner you see if running an eval version of the program or the timestamp in the -mpexport 95 file.

See the **setlocale** man pages in your UNIX or LINUX operating system to learn more about the locale command and how to set it. Windows-family computers also have localization capability, and SANtools software will report localized date/time information on PCs which have localization enabled.

1.20 Link Speed Reporting

If you have a SCSI or SAS attached-device (which also covers a SATA disk attached to a SAS controller), then chances are good that it returns the link speed. This is useful if you wish to determine if your devices are configured and cabled correctly in order to provide maximum performance. The link speed option can be called in either foreground mode (i.e, along with all of the reporting flags such as **-I** 53 or **-J** 80).

This feature can be invoked by appending the **-link** option to the command line. We added this feature as a request from a vendor that wished to monitor devices in an external RAID enclosure. The company wished to know if and when the drives were renegotiating the interface from U320 to U160 due to poor signal quality.

What is Link Speed?

The numbers below define how the Transfer Period Factor, decoded from the SCSI device, is reported by SMARTMonUX. The Common MB/sec column reports how manufacturers typically market the speed of the device.

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Standard-Defined Clocking	Common Name	Common MB/sec	Transfer Period Factor (TPF)	Reported via smartmon-ux
TPF x 4	Regular	5	32h - FFh	Fast-5 200ns
TPF x 4	Fast	10	19h - 31h	Fast-10 100ns
TPF x 4	Ultra	20	0dh - 18h	Fast-20 200ns
50 ns	Ultra 2	40	0ch	Fast-20 50ns
30.3 ns	Ultra 2	80	0bh	Fast-40 30ns
25 ns	Ultra 2	80	0ah	Fast-40 25ns
12.5 ns	Ultra 3	160	09h	U160
6.25 ns	Fast-160	320	08h	U320
3.125 ns	Fast-320	640	07h	U640

As monitoring the link speed requires additional I/Os per polling period, you would rarely enable this feature during polling. Just combine **`-link`** with one of the foreground commands, so the program will query speed then exit.

The software reports protocol-specific link speeds for SAS and Fibre Channel peripherals as well. You can see if your SAS disks are *really* running at 3 Gbit/second.

Background Link Speed Monitoring

If you send **`./smartmon-ux -F 600 -link /dev/sg[0-3]`** to your LINUX host

Then you would get something like the data below in your log file every 600 seconds in the system log file.

```
Jul 24 23:19:10 rh90 smartmon-ux[12202]: /dev/sg0 polled at Thu Jul 24 23:19:10 2003 Status:Passed (Speed: U160)
Jul 24 23:19:11 rh90 smartmon-ux[12202]: /dev/sg1 polled at Thu Jul 24 23:19:10 2003 Status:Passed (Speed: U320)
Jul 24 23:19:13 rh90 smartmon-ux[12202]: /dev/sg2 polled at Thu Jul 24 23:19:12 2003 Status:Passed (Speed: U160)
Jul 24 23:19:14 rh90 smartmon-ux[12202]: /dev/sg3 polled at Thu Jul 24 23:19:13 2003 Status:Passed (Speed: U160)
```

Foreground Link Speed Reporting (SCSI peripherals only)

The link speed is reported in mode page 19h, a somewhat cryptic value will be returned at the end of the mode page as shown below. Pass the program the **-J** 65 option to report all mode pages and look for the speed at the end of the page (highlighted in **red**).

```
Protocol Specific Port                : Page [19h] (Factory, Current, Saved)
 Physical interface                   : Parallel SCSI
 Driver strength                      : 0, 0, 0 {R/O}
 Driver asymmetry                     : 0, 0, 0 {R/O}
 Driver precompensation               : 0, 0, 0 {R/O}
 Driver slew rate                     : 1, 1, 1 {R/O}
 DB(0) Value                          : 0, 0, 0 {R/O}
 DB(1) Value                          : 0, 0, 0 {R/O}
 DB(2) Value                          : 0, 0, 0 {R/O}
 DB(3) Value                          : 0, 0, 0 {R/O}
 DB(4) Value                          : 0, 0, 0 {R/O}
 DB(5) Value                          : 0, 0, 0 {R/O}
 DB(6) Value                          : 0, 0, 0 {R/O}
 DB(7) Value                          : 0, 0, 0 {R/O}
 DB(8) Value                          : 0, 0, 0 {R/O}
 DB(9) Value                          : 0, 0, 0 {R/O}
 DB(10) Value                         : 0, 0, 0 {R/O}
 DB(11) Value                         : 0, 0, 0 {R/O}
 DB(12) Value                         : 0, 0, 0 {R/O}
 DB(13) Value                         : 0, 0, 0 {R/O}
 DB(14) Value                         : 0, 0, 0 {R/O}
 P_CRCA                               : 0, 0, 0 {R/O}
 P1                                   : 0, 0, 0 {R/O}
 BSY                                  : 0, 0, 0 {R/O}
 SEL                                  : 0, 0, 0 {R/O}
 RST                                  : 0, 0, 0 {R/O}
 REQ                                  : 0, 0, 0 {R/O}
 ACK                                  : 0, 0, 0 {R/O}
 ATN                                  : 0, 0, 0 {R/O}
```

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```
C/D                                 : 0, 0, 0 {R/O}
I/O                                 : 0, 0, 0 {R/O}
MSG                                 : 0, 0, 0 {R/O}
Transfer period factor              : 0, 0, 0 {R/O}
REQ/ACK offset timing               : 0, 0, 0 {R/O}
Transfer width exponent             : 1, 1, 1 {R/O}
Protocol options bits               : 00h, 09h, 00h
Driver asymmetry                    : 0, 0, 0 {R/O}
Sent PCOMP enabled                  : 0, 0, 0 {R/O}
Received PCOMP enabled              : 1, 1, 1 {R/O}
Min xfr period factor               : 0, 0, 0 {R/O}
Max REQ/ACK offset                  : 0, 0, 0 {R/O}
Max transfer width exponent         : 1, 1, 1 {R/O}
Protocol options bits supported     : 08h, 08h, 08h
```

By examining the Protocol options bits (which corresponds to the TPF bits in the table above), you can see that this device is currently configured for U160 mode.

Detecting Link Speed for Fibre Channel Peripherals

You can determine the link speed for fibre channel drives by using the **-fchbainfo** 129 command which is part of the SAN Reporting 128 capability in this software.

Detecting Link Speed for SAS Peripherals

You can determine the link speed by looking at the highlighted negotiated link rate 88 field in the sample output for mode page 19 88.

1.21 Log Page Viewer

Like Mode Pages, SCSI family devices (remember, this includes FC and SAS peripherals) will typically have log pages. These log pages are used to report cumulative totals. These totals may be used to assist the administrator in tuning efforts, error diagnosis, or administration tasks. The ANSI SCSI specifications allow for hundreds of log pages, as well as vendor-specific pages. To further complicate the issue, as new ANSI specifications come out, they will add new log pages, and possibly retire others.

We make an effort to maintain internal tables of both ANSI defined log pages, and vendor specific pages as well. As release levels of the code increase, additional vendor/model specific entries are always added. As log and mode page settings are sometimes vendor specific and are only released under NDA, it sometimes takes us time to get permission and the necessary information to report these settings to you.

To view all the mode pages for a particular device, in hex, enter

```
/etc/smartmon-ux -C /hw/scsi/sc2d66l0
```

-or -

```
/etc/smartmon-ux -C+ /hw/scsi/sc2d66l0
```

-or -

```
/etc/smartmon-ux -Cx /hw/scsi/sc2d66l0
```

On our IRIX development system, the device reported the below:

```
# /etc/smartmon-ux -C
SMARTMon-ux [Release 1.26, Build 22-APR-2004] - Copyright 2001-2004 SANtools, Inc. http://www.SANtools.com
Discovered SEAGATE ST336605FC S/N "3FP009Z6" on /hw/scsi/sc2d66l0 [SES] (SMART enabled) (34732 MB)
 Statistical log pages dump below [# of bytes reserved for value in device]:
   Port receiving this command 0=A, 1=B: 1 [2]
   Port A link failure count: 0 [4]
   Port A loss of synchronization count: 2 [4]
   Port A invalid transmission word count: 5 [4]
   Port A invalid CRC count: 0 [4]
   Port B link failure count: 1 [4]
   Port B loss of synchronization count: 45 [4]
   Port B invalid transmission word count: 196624 [4]
   Port B invalid CRC count: 0 [4]
   Logical blocks sent to initiators: 83780318 [4]
   Logical blocks received from initiators: 6623284 [4]
   Logical blocks read from cache, sent to initiators: 45424812 [4]
```

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```
   Number of read and write commands <= current segment size: 366966 [4]
   Number of read and write commands > current segment size: 76687 [4]
   Power-on time in minutes: 38260 [4]
   Time in minutes until the next scheduled interrupt for a S.M.A.R.T. measurement: 66 [4]
   Write errors corrected with possible delays: 0 [4]
   Total write errors: 0 [4]
   Write errors corrected: 0 [4]
   Times correction algorithm processed (on writes): 0 [4]
   Bytes processed (on writes): 3401038336 [8]
   Unrecovered errors (on writes): 0 [4]
   Read errors corrected without substantial delay: 887 [4]
   Read errors corrected with possible delays: 0 [4]
   Total read errors: 0 [4]
   Read errors corrected: 887 [4]
   Times correction algorithm processed (on reads): 887 [4]
   Bytes processed (on reads): 88372689408 [8]
   Unrecovered errors (on reads): 0 [4]
   Verify errors corrected without substantial delay: 0 [4]
   Verify errors corrected with possible delays: 0 [4]
   Total verify errors: 0 [4]
   Verify errors corrected: 0 [4]
   Times correction algorithm processed (on verifys): 0 [4]
   Bytes processed (on verifys): 0 [8]
   Unrecovered errors (on verifys): 0 [4]
   Total Non-medium errors: 0 [4]
   Current temperature +/- 3 degrees C: 37
   Reference temperature +/- 3 degrees C: 65
   Self-test (extended background): FAILED in segment #0 at Block #00000000 000238CFh @ 214 powered hours
[Drive media failed] Unrecovered read error ASC=11 ASCQ=00, SelfTestByte=00, VendorSpecificByte=E4
   Self-test (short background): Completed w/o error @ 134 powered hours
   Self-test (short background): Completed w/o error @ 24 powered hours
   Self-test (standard): Completed w/o error @ 1 powered hours
Terminating program.
```

If you sent the command with the **-Cx** option, then the numbers in brackets would be suppressed. The bracketized field shows you how many bytes the selected peripheral allocates for the resulting data. This is useful in the event you need to assess the possibility that the field rolled over (like an odometer).

```
# /etc/smartmon-ux -Cx
SMARTMon-ux [Release 1.26, Build 10-JUN-2008] - Copyright 2001-2008 SANtools, Inc. http://www.SANtools.com
Discovered SEAGATE ST336605FC S/N "3FP009Z6" on /hw/scsi/sc2d66l0 [SES] (SMART enabled) (34732 MB)
 Statistical log pages dump below [# of bytes reserved for value in device]:
   Port receiving this command 0=A, 1=B: 1
   Port A link failure count: 0
   Port A loss of synchronization count: 2
...
```

There are some interesting things to see here:

- Read or Write errors - We have 887 corrected read errors. Note that your operating system would not report recovered errors, only unrecovered errors. Recovered errors means your system successfully retried the operation, but this cost you I/O and CPU cycles. If you had any Unrecovered errors, you have some corrupted data.
- Number of minutes drive has been powered on. This disk has been powered on for 38260 minutes, nearly a month. This is a Seagate-specific setting, and certain models of disk report this value as minutes since LAST power on, while other disks report this as cumulative minutes drive has been powered on since leaving the factory. We do not differentiate between the two, because there is no 100% infallible way to tell the difference. By looking at the other statistics, however, we can make an educated guess that the drive has been up a week since last power cycle. We can tell by examining the cumulative blocks read. Our IRIX box is only used for compiling and testing code, so having 17GBs read in the 6 months we have had it is reasonable and having read 17GBs in last week is not correct.
- The number in parentheses to the right of each value tells you how many bytes that the disk maintains to store these values.
- Use that to make a judgment call to see if you have had an overflow. The disk drive does not maintain an overflow counter, so there is no way to know if you really did have a field overflow.
- You can see that the disk processed 83,780,118 blocks, but only had 45,424,812 cache hits. That corresponds to over a 54% read cache hit rate.

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- This disk is a fibre channel drive, and it has some problems on Port B.

This manual does not contain the record layout and meanings of log pages for every make and model of SCSI device. This information is typically available from your disk manufacturer's web site. If you are interested in tuning your disk or advanced problem diagnosis, you should contact your disk manufacturer and request the information. We have found that IBM and Seagate are most cooperative and have all information online. Other vendors need to be "prodded" a bit.

Now, let us look at the same disk, but view the log pages in Hex format: (You can enter **-H** or **-H+**, both will report all log pages, but the **-H+** option will perform a brute-force discovery)

```
# /etc/smartmon-ux -H | more
SMARTMon-ux [Release 1.12, Build 25-AUG-2002] - Copyright 2002 SANtools, Inc. http://www.SANtools.com
Discovered SEAGATE ST336605FC S/N "3FP009Z6" on /hw/scsi/sc2d66l0 [SES] (SMART enabled) (34732 MB)
[Adapter/ID.LUN=4/4.0](34732 MB)
 Statistical log pages raw dump below:
  Log page 00h:
   0000: 00 00 00 0A 00 02 03 05 06 0D 10 37 3D 3E          ...........7=>
  Log page 02h:
   0000: 02 00 00 34 00 01 20 04 00 00 00 00 00 02 20 04    ...4.. ....... .
   0010: 00 00 00 00 00 03 20 04 00 00 00 00 00 04 20 04    ...... ....... .
   0020: 00 00 00 00 00 05 20 08 00 00 00 00 CA B7 BA 00    ...... .........
   0030: 00 06 20 04 00 00 00 00                            .. .....
  Log page 03h:
   0000: 03 00 00 3C 00 00 20 04 00 00 03 77 00 01 20 04    ...<.. ....w.. .
   0010: 00 00 00 00 00 02 20 04 00 00 00 00 00 03 20 04    ...... ....... .
   0020: 00 00 03 77 00 04 20 04 00 00 03 77 00 05 20 08    ...w.. ....w.. .
   0030: 00 00 00 14 93 6C 3A 00 00 06 20 04 00 00 00 00    .....l:... .....
  Log page 05h:
   0000: 05 00 00 3C 00 00 20 04 00 00 00 00 00 01 20 04    ...<.. ....... .
   0010: 00 00 00 00 00 02 20 04 00 00 00 00 00 03 20 04    ...... ....... .
   0020: 00 00 00 00 00 04 20 04 00 00 00 00 00 05 20 08    ...... ....... .
   0030: 00 00 00 00 00 00 00 00 06 20 04 00 00 00 00       ......... .....
  Log page 06h:
   0000: 06 00 00 08 00 00 20 04 00 00 00 00                ...... .....
  Log page 0Dh:
   0000: 0D 00 00 78 00 00 20 02 00 24 00 01 20 02 00 41    ...x.. ..$.. ..A
   0010: 00 02 20 02 00 24 80 FF 20 02 00 01 81 00 20 04    .. ..$.. ..... .
   0020: 00 00 00 00 81 01 20 04 00 00 00 02 81 02 20 04    ...... ....... .
   0030: 00 00 00 00 81 03 20 04 00 00 00 00 81 04 20 04    ...... ....... .
   0040: 00 00 00 05 81 05 20 04 00 00 00 00 81 10 20 04    ...... ....... .
   0050: 00 00 00 01 81 11 20 04 00 00 00 2D 81 12 20 04    ...... ....-.. .
   0060: 00 00 00 00 81 13 20 04 00 00 00 00 81 14 20 04    ...... ....... .
   0070: 00 03 00 10 81 15 20 04 00 00 00 00                ...... .....
  Log page 10h:
   0000: 10 00 01 90 00 01 03 10 20 00 00 00 FF FF FF FF    ........ .......
   0010: FF FF FF FF 00 00 00 00 00 02 03 10 20 00 00 00    ............ ...
   0020: FF FF FF FF FF FF FF FF 00 00 00 00 00 03 03 10    ................
   0030: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
   0040: 00 04 03 10 00 00 00 00 00 00 00 00 00 00 00 00    ................
   0050: 00 00 00 00 00 05 03 10 00 00 00 00 00 00 00 00    ................
   0060: 00 00 00 00 00 00 00 00 00 06 03 10 00 00 00 00    ................
   0070: 00 00 00 00 00 00 00 00 00 00 00 00 00 07 03 10    ................
   0080: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
   0090: 00 08 03 10 00 00 00 00 00 00 00 00 00 00 00 00    ................
   00a0: 00 00 00 00 00 09 03 10 00 00 00 00 00 00 00 00    ................
   00b0: 00 00 00 00 00 00 00 00 00 00 0A 03 10 00 00 00    ................
   00c0: 00 00 00 00 00 00 00 00 00 00 00 00 00 0B 03 10    ................
   00d0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
   00e0: 00 0C 03 10 00 00 00 00 00 00 00 00 00 00 00 00    ................
   00f0: 00 00 00 00 00 0D 03 10 00 00 00 00 00 00 00 00    ................
   0100: 00 00 00 00 00 00 00 00 00 0E 03 10 00 00 00 00    ................
   0110: 00 00 00 00 00 00 00 00 00 00 00 00 00 0F 03 10    ................
   0120: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
   0130: 00 10 03 10 00 00 00 00 00 00 00 00 00 00 00 00    ................
   0140: 00 00 00 00 00 11 03 10 00 00 00 00 00 00 00 00    ................
   0150: 00 00 00 00 00 00 00 00 00 12 03 10 00 00 00 00    ................
   0160: 00 00 00 00 00 00 00 00 00 00 00 00 00 13 03 10    ................
```

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```
  0170: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  0180: 00 14 03 10 00 00 00 00 00 00 00 00 00 00 00 00    ................
  0190: 00 00 00 00                                        ....
 Log page 37h:
  0000: 37 00 00 28 00 00 20 04 04 FE 62 DE 00 01 20 04    7..(.. ...b... .
  0010: 00 65 10 34 00 02 20 04 02 B5 20 AC 00 03 20 04    .e.4.. ... ... .
  0020: 00 05 99 76 00 04 20 04 00 01 2B 8F                ...v.. ...+.
 Log page 3Dh:
  0000: 3D 00 00 F0 00 01 00 06 0A 00 01 00 00 00 00 03    =...............
  0010: 00 E2 0A 00 01 FF FF FF FF FF FF FF FF 02 FF FF    ................
  0020: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF    ................
  0030: 02 FF FF FF FF FF FF FF FF 02 FF FF FF FF FF FF    ................
  0040: FF FF FF FF FF FF FF FF FF FF FF FF 03 FF FF FF    ................
  0050: FF FF FF FF FF 02 FF FF FF FF FF FF FF FF FF FF    ................
  0060: FF FF FF FF FF FF FF FF 04 FF FF FF FF FF FF FF    ................
  0070: FF 02 FF FF FF FF FF FF FF FF FF FF FF FF FF FF    ................
  0080: FF FF FF FF 05 FF FF FF FF FF FF FF FF 02 FF FF    ................
  0090: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF    ................
  00a0: 06 FF FF FF FF FF FF FF FF 02 FF FF FF FF FF FF    ................
  00b0: FF FF FF FF FF FF FF FF FF FF FF FF 07 FF FF FF    ................
  00c0: FF FF FF FF FF 02 FF FF FF FF FF FF FF FF FF FF    ................
  00d0: FF FF FF FF FF FF FF FF 08 FF FF FF FF FF FF FF    ................
  00e0: FF 02 FF FF FF FF FF FF FF FF FF FF FF FF FF FF    ................
  00f0: FF FF FF FF                                        ....
 Log page 3Eh:
  0000: 3E 00 00 10 00 00 20 04 00 00 95 7F 00 08 20 04    >..... ....... .
  0010: 00 00 00 36                                        ...6
```

The values above really only make sense if you have the programming manual specific for your disk drive.

As written before, we try to maintain a list of log pages for the most common makes and models. If the -C output does not return anything, but the **-H** dump does, your peripheral is not in our database. Please contact us if that is the case, and we will make best efforts to revise the database for you.

Some devices aren't ANSI compliant, and do not properly supply log page #0, which is a list of valid log pages. If log page entries do not appear, you may have luck if you use **-C+** or **-H+** instead of **-C** and **-H**. This instructs the software to use a brute-force discovery process.

Also note that even if the disk is in the database, we may not decode all of the log page information. That is because not all fields are in a standard format, and have to be manually decoded. We apologize for this. We choose to report the most common information that people would be interested in. If you desire all of the possibly hundreds of fields yourself, we give you the hex dump above to make that possible.

Self-Test Results Syntax Changes for Release 1.26

In version 1.26, we added **additional information** 68 to the self-test results. Previously, it just reported the test type, block number (if failure detected) and powered hours at the time the test was run. It also only reported the previous 3 results.

Now, the program reports the last 20 self-test results (if applicable), the sense data and description of error(s) found, and the values of vendor-unique bytes which would be of value to your disk vendor in event an error is discovered.

1.21.1 Example Decoded Log Page Dump - SAS Disk

The results below were run under SPARC Solaris 10 using a Seagate ST3146855SS SAS disk.

```
# /etc/smartmon-ux -C /dev/rdsk/c4t17d0s0
SMARTMon-UX [Release 1.36, Build  8-JUN-2008] - Copyright 2001-2008 SANtools(R), Inc. http://www.SANtools.
com
Discovered SEAGATE ST3146855SS S/N "3LN29QG4" on /dev/rdsk/c4t17d0s0 (SMART enabled)(140014 MB)

 Statistical log pages dump below [# of bytes reserved for value in device]:
   Write errors corrected with possible delays: 0 [4]
```

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```
  Total Write errors: 0 [4]
  Write errors corrected: 0 [4]
  Times correction algorithm processed (on Writes): 0 [4]
  Bytes processed (on Writes): 353948013568 [8]
  Unrecovered errors (on Writes): 0 [4]
  Read errors corrected without substantial delay: 605260 [4]
  Read errors corrected with possible delays: 9 [4]
  Total Read errors: 0 [4]
  Read errors corrected: 605269 [4]
  Times correction algorithm processed (on Reads): 605996 [4]
  Bytes processed (on Reads): 652188835328 [8]
  Unrecovered errors (on Reads): 727 [4]
  Verify errors corrected without substantial delay: 590 [4]
  Verify errors corrected with possible delays: 0 [4]
  Total Verify errors: 0 [4]
  Verify errors corrected: 590 [4]
  Times correction algorithm processed (on Verifys): 590 [4]
  Bytes processed (on Verifys): 0 [8]
  Unrecovered errors (on Verifys): 0 [4]
  Total Non-medium errors: 0 [4]
  Current temperature +/- 3 degrees C: 32
  Reference temperature +/- 3 degrees C: 68
  Background scanning status: 8
  Number of background scans performed: 35
  Background scan percentage completed: 35
  SAS Phy #0 (50-00-C5-00-06-94-BF-FD) - Invalid dwords:  0
  SAS Phy #0 (50-00-C5-00-06-94-BF-FD) - Running disparity errors:  0
  SAS Phy #0 (50-00-C5-00-06-94-BF-FD) - Loss of dword syncs:  0
  SAS Phy #0 (50-00-C5-00-06-94-BF-FD) - Reset problems:  0

Program Ended.
```

Note that the dump provides on the SAS world wide names and transport errors 69.

1.21.2 Example Decoded Log Page Dump - FC Disk

The results below were run under SPARC Solaris 10 using a Seagate ST336704FC Fibre Channel disk.

```
# /etc/smartmon-ux -C /dev/rdsk/c1t2d0s0
SMARTMon-UX [Release 1.36, Build  8-JUN-2008] - Copyright 2001-2008 SANtools(R), Inc. http://www.SANtools.
com
Discovered SEAGATE ST336704FC S/N "3CD0W3AV" on /dev/rdsk/c1t2d0s0 [SES] (SMART enabled)(35003 MB)

 Statistical log pages dump below [# of bytes reserved for value in device]:
   Port receiving this command 0=A, 1=B: 0 [2]
   Port A link failure count: 0 [4]
   Port A loss of synchronization count: 7 [4]
   Port A invalid transmission word count: 0 [4]
   Port A invalid CRC count: 0 [4]
   Port B link failure count: 1 [4]
   Port B loss of synchronization count: 1 [4]
   Port B invalid transmission word count: 0 [4]
   Port B invalid CRC count: 0 [4]
   Logical blocks sent to initiators: 17096691 [4]
   Logical blocks received from initiators: 162586438 [4]
   Logical blocks read from cache, sent to initiators: 637366 [4]
   Number of read and write commands <= current segment size: 5696043 [4]
   Number of read and write commands > current segment size: 1694 [4]
   Power-on time in minutes: 198640 [4]
   Time in minutes until the next scheduled interrupt for a S.M.A.R.T. measurement: 104 [4]
   Write errors corrected with possible delays: 0 [4]
   Total Write errors: 0 [4]
   Write errors corrected: 0 [4]
   Times correction algorithm processed (on Writes): 0 [4]
   Bytes processed (on Writes): 106982397952 [8]
   Unrecovered errors (on Writes): 0 [4]
   Read errors corrected without substantial delay: 21 [4]
   Read errors corrected with possible delays: 0 [4]
   Total Read errors: 0 [4]
```

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```
   Read errors corrected: 21 [4]
   Times correction algorithm processed (on Reads): 21 [4]
   Bytes processed (on Reads): 134854044160 [8]
   Unrecovered errors (on Reads): 0 [4]
   Verify errors corrected without substantial delay: 0 [4]
   Verify errors corrected with possible delays: 0 [4]
   Total Verify errors: 0 [4]
   Verify errors corrected: 0 [4]
   Times correction algorithm processed (on Verifys): 0 [4]
   Bytes processed (on Verifys): 1229312 [8]
   Unrecovered errors (on Verifys): 0 [4]
   Total Non-medium errors: 2 [4]
   Current temperature +/- 3 degrees C: 40
   Reference temperature +/- 3 degrees C: 65
   Self-test (extended background): Aborted by application @ 2344 powered hours [No Error] SelfTestByte=00,
VendorSpecificByte=00
   Self-test (extended background): Aborted by application @ 2344 powered hours [No Error] SelfTestByte=00,
VendorSpecificByte=00
   Self-test (extended background): Aborted by application @ 2344 powered hours [No Error] SelfTestByte=00,
VendorSpecificByte=00
   Self-test (short background): Aborted by application @ 2344 powered hours [No Error] SelfTestByte=00,
VendorSpecificByte=00
   Self-test (short background): Completed w/o error @ 2344 powered hours [No Error] SelfTestByte=00,
VendorSpecificByte=00
   Self-test (short background): Completed w/o error @ 2344 powered hours [No Error] SelfTestByte=00,
VendorSpecificByte=00
   Self-test (short background): Completed w/o error @ 2343 powered hours [No Error] SelfTestByte=00,
VendorSpecificByte=00
   Self-test (short background): Completed w/o error @ 2343 powered hours [No Error] SelfTestByte=00,
VendorSpecificByte=00
   Self-test (short background): Completed w/o error @ 2284 powered hours [No Error] SelfTestByte=00,
VendorSpecificByte=00
   Self-test (extended background): Completed w/o error @ 2280 powered hours [No Error] SelfTestByte=00,
VendorSpecificByte=00
   Self-test (extended background): Completed w/o error @ 2279 powered hours [No Error] SelfTestByte=00,
VendorSpecificByte=00
   Self-test (extended background): Aborted by application @ 2278 powered hours [No Error] SelfTestByte=00,
VendorSpecificByte=00
   Self-test (extended background): Aborted by application @ 2278 powered hours [No Error] SelfTestByte=00,
VendorSpecificByte=00
   Self-test (short background): Aborted by application @ 2278 powered hours [No Error] SelfTestByte=00,
VendorSpecificByte=00
   Self-test (short background): Completed w/o error @ 2278 powered hours [No Error] SelfTestByte=00,
VendorSpecificByte=00
   Self-test (short background): Completed w/o error @ 0 powered hours [No Error] SelfTestByte=00,
VendorSpecificByte=00
   Self-test (short background): Completed w/o error @ 0 powered hours [No Error] SelfTestByte=00,
VendorSpecificByte=00


Program Ended.
```

Note the cumulative errors on the fibre channel A and B 69 ports, and the extensive self-test results 70.

1.21.3 Example Decoded Log Page Dump - SCSI Disk

The results below were run under Windows XP using a HP 36 GB SCSI Disk.

```
C>\scratch>smartmon-ux -Cx \\.\PHYSICALDRIVE1
SMARTMon-UX [Release 1.36, Build  8-JUN-2008] - Copyright 2001-2008 SANtools(R), Inc. http://www.SANtools.
com
Discovered HP 36.4G MAU3036NC S/N "KY010344" on \\.\PHYSICALDRIVE1 (Not Enabling SMART) [Bus/Port/ID.
LUN=0/2/9.0](34732 MB)

 Statistical log pages dump below [# of bytes reserved for value in device]:
   Buffer under-runs: 0
   Buffer over-runs: 0
   Write errors corrected without substantial delay: 0
   Write errors corrected with possible delays: 0
```

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```
   Total Write errors: 0
   Write errors corrected: 0
   Times correction algorithm processed (on Writes): 0
   Unrecovered errors (on Writes): 0
   Read errors corrected without substantial delay: 0
   Read errors corrected with possible delays: 0
   Total Read errors: 0
   Read errors corrected: 0 [4]
   Times correction algorithm processed (on Reads): 0
   Unrecovered errors (on Reads): 0
   Verify errors corrected without substantial delay: 0
   Verify errors corrected with possible delays: 0
   Total Verify errors: 0
   Verify errors corrected: 0
   Times correction algorithm processed (on Verifys): 0
   Unrecovered errors (on Verifys): 0
   Total Non-medium errors: 28746
   Current temperature +/- 3 degrees C: 38
   Reference temperature +/- 3 degrees C: 65
   Current temperature +/- 3 degrees C: 38
   Reference temperature +/- 3 degrees C: 65
   Device manufactured (week/year): 16/2005
   Specified max start-stop cycle count: 10000
   Accumulated start-stop cycles: 353
   Self-test (extended background): Completed w/o error @ 112 powered hours [No Error] SelfTestByte=00,
VendorSpecificByte=00
   Current temperature +/- 3 degrees C: 38


Program Ended.
```

(Note that this report uses **-Cx** variant to suppress the trailing bracketized log data.

1.21.4 Example Decoded Log Page Dump - SCSI Tape

The results below were run under Windows XP using a HP 36 GB SCSI Disk.

```
C>\scratch>smartmon-ux -Cx \\.\TAPE0

SMARTMon-UX [Release 1.41, Build  1-NOV-2009] - Copyright 2001-2009 SANtools(R), Inc. http://www.SANtools.
com
Discovered TANDBERG SLR7 S/N "SN007005396" on \\.\TAPE0 (tape) [Bus/Port/ID.LUN=0/3/12.0]
 Statistical log pages dump below [# of bytes reserved for value in device]:
   Total logical data blocks transferred: 7248
   Total physical blocks written to media: 55023104
   Total physical blocks read from media (Read and Space operations only): 101376
   Approx remaining capacity of partition 0 (in KBytes): 19690708
   Approx remaining capacity of current partition (in KBytes): 19690708
   Approx maximum capacity of partition 0 (in KBytes): 19690708
   Approx maximum capacity of current partition (in KBytes): 19690708
   Number of file marks: 9
   Number of set marks: 0
   Number of minutes of motion since last head cleaning: 94
   Number of head cleanings: 5
   Total power-on minutes: 360949
   Total number of cartridge loads: 146
   Number of servo lock retries: 0
   Number of servo track seeks: 0
   Number of lost servo locks on writes: 0
   Number of write servo dropouts: 0
   Number of lost servo locks on reads: 0
   Number of read servo dropouts: 0
   Current selected track number: 0
   Cartridge serial number: 496256
   Number of times this cartridge loaded: 18
   Number of beginning-of-tape markers passed for this tape: 253
   Number of end-of-tape markers passed for this tape: 14
   Number of cartridge write past counters: 27
   Number of minutes cartridge has been in motion: 121
   Write compression ratio (percentage - reset on cartridge change): 168
```

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```
   Read compression ratio (percentage - reset on cartridge change): 0
   Percentage of data with compression between .89 and 1.2 - reset on cartridge change: 0
   Percentage of data with compression between 1.2 and 1.6 - reset on cartridge change: 28
   Percentage of data with compression between 1.6 and 2.2 - reset on cartridge change: 71
   Percentage of data with compression between 2.2 and 3.6 - reset on cartridge change: 0
   Percentage of data with compression greater than 3.6 - reset on cartridge change: 0
   Buffer under-runs: 22
   Buffer over-runs: 1
   Write errors corrected with possible delays: 155808
   Total Write errors: 345
   Write errors corrected: 345
   Times correction algorithm processed (on Writes): 0
   Bytes processed (on Writes): 295436288
   Unrecovered errors (on Writes): 0
   Read errors corrected with possible delays: 0
   Total Read errors: 1
   Read errors corrected: 1
   Times correction algorithm processed (on Reads): 1
   Bytes processed (on Reads): 7602176
   Unrecovered errors (on Reads): 0


Program Ended.
```

The log pages provide a great deal of insight when dealing with tape and autochangers. Consider how valuable the highlighted fields are when dealing with software vs. hardware compression; data integrity; tape rotation; and so on. The buffer under-runs tells us that that tape drive couldn't keep up with the data stream, and buffer under-runs tells us how many times the host couldn't keep up with the tape.

1.22 SMART Threshold and Attribute Viewer

Threshold and attributes are only applicable for IDE disk drives (which includes SATA disks).
SCSI and Fibre Channel drives provide additional statistical information which may be viewed by examining the log pages 65.

With version 1.28, we added additional information to the **-S** output. Previously we would report something like:

```
SMARTMon-ux [Release 1.23, Build 07-DEC-2003] - Copyright 2003 SANtools, Inc. http://www.SANtools.com
Discovered Maxtor 6Y080M0 S/N "Y3JRAGXE" on /dev/hda (SMART Enabled)
 S.M.A.R.T. Attributes and Thresholds (Note - Alert made if Current BELOW threshold):
  Attribute# and Description                    Flags  Current Worst Threshold
   (3) Spin Up Time:                            0x0027   205    205      63
   (4) Start/Stop Count:                        0x0032   253    253       0
   (5) Reallocated Sector Count:                0x0033   253    253      63
   (6) Read Channel Margin                      0x0001   253    253     100
   (7) Seek Error Rate:                         0x000a   253    252       0
   (8) Seek Time Performance:                   0x0027   253    251     187
   (9) Power On Hours Count:                    0x0032   253    253       0
  (10) Spin Retry Count:                        0x002b   253    252     157
  (11) Calibration Retry Count:                 0x002b   253    252     223
  (12) Power Cycles:                            0x0032   253    253       0
(192) Emergency Retract Cycles:                 0x0032   253    253       0
(193) Load/Unload Cycles:                       0x0032   253    253       0
(194) HDD Temperature:                          0x0032   253    253       0
(195) On The Fly Error Rate:                    0x000a   253    252       0
(196) Offline Reallocation Events:              0x0008   253    253       0
(197) Probational Sector Count:                 0x0008   253    253       0
(198) Scan Uncorrectable Sectors:               0x0008   253    253       0
(199) CRC Errors:                               0x0008   199    199       0
(200) Write Preamp Errors:                      0x000a   253    252       0
(201) Off Track Errors:                         0x000a   253    252       0
(202) DAM Error Rate:                           0x000a   253    252       0
(203) ECC Errors:                               0x000b   253    252     180
(204) Raw Read Error Rate:                      0x000a   253    252       0
(205) Thermal Asperity Rate:                    0x000a   253    252       0
(207) Spin High Current:                        0x002a   253    252       0
(208) Spin Buzz:                                0x002a   253    252       0
(209) Off Line Seek Performance:                0x0024   198    198       0
( 99) Unknown (vendor-specific) Attribute:      0x0004   253    253       0
```

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```
(100) Unknown (vendor-specific) Attribute:       0x0004   253    253       0
(101) Unknown (vendor-specific) Attribute:       0x0004   253    253       0
 The current hard disk temperature is:  36C (96F) degrees
```

Now we report ...

```
SMARTMon-ux [Release 1.28, Build 01-APR-2005] - Copyright 2001-2005 SANtools, Inc. http://www.SANtools.com
Discovered Maxtor 5A250J0 S/N "A80F8323" on /dev/hda (SMART Enabled)(239372 MB)
 S.M.A.R.T. Attributes and Thresholds (Note - Alert made if Current BELOW threshold):
  Attribute# and Description                    Flags  Current Worst Threshold     Value  [Notes]
  (3) Spin Up Time:                             0x0027   207    204      63        10069
  (4) Start/Stop Count:                         0x0032   253    253       0          153
  (5) Reallocated Sector Count:                 0x0033   253    253      63            0
  (6) Read Channel Margin                       0x0001   253    253     100            0
  (7) Seek Error Rate:                          0x000a   253    252       0            0
  (8) Seek Time Performance:                    0x0027   252    248     187        36100
  (9) Power On Hours Count:                     0x0032   234    234       0        15927  [11 days 01 hrs
27 min]
 (10) Spin Retry Count:                         0x002b   253    252     157            0
 (11) Calibration Retry Count:                  0x002b   253    252     223            0
 (12) Power Cycles:                             0x0032   253    253       0          170
( 99) Unknown (vendor-specific) Attribute:      0x0004   253    253       0            0
(100) Unknown (vendor-specific) Attribute:      0x0004   253    253       0            0
(101) Unknown (vendor-specific) Attribute:      0x0004   253    253       0            0
(192) Emergency Retract Cycles:                 0x0032   253    253       0            0
(193) Load/Unload Cycles:                       0x0032   253    253       0            0
(194) HDD Temperature (Degrees C):              0x0032   253    253       0           24  [24C]
(195) On The Fly Error Rate:                    0x000a   253    252       0        32404
(196) Offline Reallocation Events:              0x0008   253    253       0            0
(197) Probational Sector Count:                 0x0008   253    253       0            0
(198) Scan Uncorrectable Sectors:               0x0008   253    253       0            0
(199) CRC Errors:                               0x0008   198    188       0           11
(200) Write Preamp Errors:                      0x000a   253    252       0            0
(201) Off Track Errors:                         0x000a   253    247       0          332
(202) DAM Error Rate:                           0x000a   253    252       0            0
(203) ECC Errors:                               0x000b   253    252     180            0
(204) Raw Read Error Rate:                      0x000a   253    252       0            0
(205) Thermal Asperity Rate:                    0x000a   253    252       0            0
(207) Spin High Current:                        0x002a   253    252       0            0
(208) Spin Buzz:                                0x002a   253    252       0            0
(209) Off Line Seek Performance:                0x0024   253    253       0            0
 The current device temperature is:  24C (75F) degrees
```

First and foremost, ***the above information should not be used to estimate remaining life in a device***. The attributes and thresholds are all vendor/drive specific, and only the manufacturer has the technical expertise to interpret this information. It is our desire to make it available to you, so you may discuss this information with your supplier in event of a drive problem.

In the event of a S.M.A.R.T. alert, you should immediately back up your data. After that, contact your vendor to request an RMA and tell them you have a S.M.A.R.T. alert. If your disk is under warranty, they will work out the details of a drive replacement.

After your replacement is on the way and *after* you have backed up your data, you may then contact your drive vendor's technical support and ask them to interpret the above information in order to determine either root cause, or expected life. Depending on many factors, they may or may not offer to provide this analysis. (Primarily, they will not bother to do it unless you are a really good customer of theirs, and/or you are having multiple drive failures).

You should also be aware that you may have a *false error*. This is where the S.M.A.R.T. firmware in your drive initiates an alert, but the drive is fine. A common cause of false errors is if your disk drive has had power supply problems, or is exposed to radical temperature changes in a short amount of time. Before shipping your drive off for replacement, you should contact your supplier and ask them to interpret the data to determine if a false error is likely. *(It has been our experience that vendors would rather just replace the drive rather than perform this analysis.)*

Note that the last line contains the hard disk temperature. We can currently only report temperature for most of Maxtor's ATA and SATA disk drives, and some WD disks. Support is added for other disks as we obtain the

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vendor-specific programming information as we obtain this information.

1.23 SMART Error Log Reporting

IDE type disk drives, whether they use serial ATA (SATA) or parallel ATA (PATA or just ATA) interfaces, offer an abundance of diagnostic and reporting capability. They are part of the SMART command set which is supported in all but the earliest generation of ATA disk drives. The error logging contains volatile and non-volatile information and you can somewhat equate that to the log page reporting 65 found in SCSI family disk drives.

This feature was released in version 1.23.

Usage:

smartmon-ux -O [options] 17 [device_list] 22

Sample Output:

```
[root@morph smartmon]# ./smartmon-ux -O
SMARTMon-ux [Release 1.23, Build 07-DEC-2003] - Copyright 2003 SANtools, Inc. http://www.SANtools.com
Discovered Maxtor 6Y080M0 S/N "Y3JRAGXE" on /dev/hda (SMART Enabled)
  Cumulative errors recorded by disk:              0

Discovered SEAGATE ST39102LC S/N "LJT22233" on /dev/sda (SMART enabled)(8683 MB)

Discovered SEAGATE ST39102LC S/N "ZJ904241" on /dev/sdb (SMART enabled)(8683 MB)

Program Ended.
```

Analysis: Note that this command was issued on a system that had two SCSI disks and an ATA disk. The ATA disk at /dev/hda reported no errors, and the two SCSI Seagate disks ignored the command entirely since the SMART Error Log Reporting is a feature that is unique to SATA and PATA disks.

```
[root@rh90 smartmon]# ./smartmon-ux -O
SMARTMon-ux [Release 1.23, Build 07-DEC-2003] - Copyright 2003 SANtools, Inc. http://www.SANtools.com
Discovered ExcelStor Technology ES3220 S/N "KF11MPL" on /dev/hdc (SMART Enabled)

  Cumulative errors recorded by disk:              157 (Last 5 entries only)
    Error #(157) Contents of registers when command register was written:
     Device state field byte and description:      00 (Unknown)
     Timestamp (lifetime powered-up hours):        9999
     ERROR Register:                               04
     STATUS Register:                              00
     SECTOR Register:                              00
     LBA LOW Register:                             00
     LBA MIDDLE Register:                          00
     LBA HIGH Register:                            00
     DEVICE Register:                              E0
     Extended error bytes:                         00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
     Listing of previous 5 commands executed before error (reverse-sequential):
       Time(secs) Command  Feature   Sector  LBA Low  LBA Mid LBA High   Device  DevCtrl  Command
Description
       ---------  -------  -------   ------  -------  ------- --------   ------  -------
-----------------------
         0.009       F8       00       00       00       00       00       E0       00    READ NATIVE MAX
ADDRESS
         0.009       10       00       3F       00       00       00       A0       00    RECALIBRATE
         0.009       91       00       3F       3F       FF       3F       AF       00    INITIALIZE DEVICE
PARAMETERS
         0.048       EF       03       42       00       00       00       A0       00    SET FEATURES [Set
transfer mode]
         0.044       EC       00       00       00       00       00       A0       00    IDENTIFY DEVICE
    Error #(156) Contents of registers when command register was written:
     Device state field byte and description:      00 (Unknown)
     Timestamp (lifetime powered-up hours):        9996
     ERROR Register:                               04
     STATUS Register:                              00
     SECTOR Register:                              00
```

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```
     LBA LOW Register:                       00
     LBA MIDDLE Register:                    00
     LBA HIGH Register:                      00
     DEVICE Register:                        E0
     Extended error bytes:                   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
     Listing of previous 5 commands executed before error (reverse-sequential):
       Time(secs) Command  Feature   Sector  LBA Low  LBA Mid LBA High   Device  DevCtrl  Command
Description
       ---------  -------  -------   ------  -------  ------- --------   ------  -------
-----------------------
         0.057       F8       00       00       00       00       00       E0       00    READ NATIVE MAX
ADDRESS
         0.055       10       00       3F       00       00       00       A0       00    RECALIBRATE
         0.055       91       00       3F       3F       FF       3F       AF       00    INITIALIZE DEVICE
PARAMETERS
         0.030       EF       03       42       00       00       00       A0       00    SET FEATURES [Set
transfer mode]
         0.025       EC       00       00       00       00       00       A0       00    IDENTIFY DEVICE
    Error #(155) Contents of registers when command register was written:
     Device state field byte and description:       00 (Unknown)
     Timestamp (lifetime powered-up hours):         9992
     ERROR Register:                                04
     STATUS Register:                               00
     SECTOR Register:                               00
     LBA LOW Register:                              00
     LBA MIDDLE Register:                           00
     LBA HIGH Register:                             00
     DEVICE Register:                               E0
     Extended error bytes:                          00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
     Listing of previous 5 commands executed before error (reverse-sequential):
       Time(secs) Command  Feature   Sector  LBA Low  LBA Mid LBA High   Device  DevCtrl  Command
Description
       ---------  -------  -------   ------  -------  ------- --------   ------  -------
-----------------------
         0.043       F8       00       00       00       00       00       E0       00    READ NATIVE MAX
ADDRESS
         0.043       10       00       3F       00       00       00       A0       00    RECALIBRATE
         0.043       91       00       3F       3F       FF       3F       AF       00    INITIALIZE DEVICE
PARAMETERS
         0.016       EF       03       42       00       00       00       A0       00    SET FEATURES [Set
transfer mode]
         0.011       EC       00       00       00       00       00       A0       00    IDENTIFY DEVICE
    Error #(154) Contents of registers when command register was written:
     Device state field byte and description:       00 (Unknown)
     Timestamp (lifetime powered-up hours):         9990
     ERROR Register:                                04
     STATUS Register:                               00
     SECTOR Register:                               00
     LBA LOW Register:                              00
     LBA MIDDLE Register:                           00
     LBA HIGH Register:                             00
     DEVICE Register:                               E0
     Extended error bytes:                          00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
     Listing of previous 5 commands executed before error (reverse-sequential):
       Time(secs) Command  Feature   Sector  LBA Low  LBA Mid LBA High   Device  DevCtrl  Command
Description
       ---------  -------  -------   ------  -------  ------- --------   ------  -------
-----------------------
         0.042       F8       00       00       00       00       00       E0       00    READ NATIVE MAX
ADDRESS
         0.042       10       00       3F       00       00       00       A0       00    RECALIBRATE
         0.042       91       00       3F       3F       FF       3F       AF       00    INITIALIZE DEVICE
PARAMETERS
         0.017       EF       03       42       00       00       00       A0       00    SET FEATURES [Set
transfer mode]
         0.012       EC       00       00       00       00       00       A0       00    IDENTIFY DEVICE
    Error #(153) Contents of registers when command register was written:
     Device state field byte and description:       00 (Unknown)
     Timestamp (lifetime powered-up hours):         9981
     ERROR Register:                                04
     STATUS Register:                               00
```

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```
     SECTOR Register:                          00
     LBA LOW Register:                         00
     LBA MIDDLE Register:                      00
     LBA HIGH Register:                        00
     DEVICE Register:                          E0
     Extended error bytes:                     00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
     Listing of previous 5 commands executed before error (reverse-sequential):
       Time(secs) Command  Feature   Sector  LBA Low  LBA Mid LBA High   Device  DevCtrl  Command
Description
       ---------  -------  -------   ------  -------  ------- --------   ------  -------
-----------------------
         0.049       F8       00       00       00       00       00       E0       00    READ NATIVE MAX
ADDRESS
         0.049       10       00       3F       00       00       00       A0       00    RECALIBRATE
         0.049       91       00       3F       3F       FF       3F       AF       00    INITIALIZE DEVICE
PARAMETERS
         0.023       EF       03       42       00       00       00       A0       00    SET FEATURES [Set
transfer mode]
         0.018       EC       00       00       00       00       00       A0       00    IDENTIFY DEVICE
  Note:  All ATA registers represented by single HEX byte. The timestamp represents the elapsed
    time in seconds since previous power=on. This wraps back to zero approximately every 50 days because
that
    represents 2 ^ 32 milliseconds. Only the last 5 errors are retained by the disk drive per ANSI
specification.

Discovered Maxtor 5A250J0 S/N "A80F545E" on /dev/hdd (SMART Enabled)

  Cumulative errors recorded by disk:              34 (Last 5 entries only)
    Error #(34) Contents of registers when command register was written:
     Device state field byte and description:      00 (Unknown)
     Timestamp (lifetime powered-up hours):        1133
     ERROR Register:                               84 (Error: ICRC, ABORT)
     STATUS Register:                              51 (Error: DRDY, DSC, ERR)
     SECTOR Register:                              00
     LBA LOW Register:                             00
     LBA MIDDLE Register:                          00
     LBA HIGH Register:                            00
     DEVICE Register:                              E0
     Extended error bytes:                         8E A0 4C 1B 00 00 03 00 9C 0B 06 00 00 00 00 00 00 0C
     Listing of previous 5 commands executed before error (reverse-sequential):
       Time(secs) Command  Feature   Sector  LBA Low  LBA Mid LBA High   Device  DevCtrl  Command
Description
       ---------  -------  -------   ------  -------  ------- --------   ------  -------
-----------------------
       368.768       C8       00       01       00       00       00       E0       08    READ DMA
       352.416       90       00       FF       3E       C5       FA       A0       08    EXECUTE DEVICE
DIAGNOSTIC
       352.416       EC       00       00       3E       C5       FA       A0       08    IDENTIFY DEVICE
       338.032       40       00       01       3E       C5       FA       E0       08    READ VERIFY
SECTOR(S)
       337.904       E3       03       00       01       4F       C2       A0       08    IDLE
    Error #(33) Contents of registers when command register was written:
     Device state field byte and description:      00 (Unknown)
     Timestamp (lifetime powered-up hours):        1133
     ERROR Register:                               84 (Error: ICRC, ABORT)
     STATUS Register:                              51 (Error: DRDY, DSC, ERR)
     SECTOR Register:                              00
     LBA LOW Register:                             80
     LBA MIDDLE Register:                          61
     LBA HIGH Register:                            0F
     DEVICE Register:                              E0
     Extended error bytes:                         18 C0 47 1B 00 00 03 00 6E 72 02 00 B0 03 00 0B 00 00 0C
     Listing of previous 5 commands executed before error (reverse-sequential):
       Time(secs) Command  Feature   Sector  LBA Low  LBA Mid LBA High   Device  DevCtrl  Command
Description
       ---------  -------  -------   ------  -------  ------- --------   ------  -------
-----------------------
      1556.496       C8       00       08       80       61       0F       E0       08    READ DMA
      1556.480       C6       00       10       00       00       00       E0       08    SET MULTIPLE MODE
      1556.480       10       00       3F       00       00       00       E0       08    RECALIBRATE
      1467.984       E1       00       00       80       61       0F       E0       0E    IDLE IMMEDIATE
```

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```
      1467.984       E1       00       00       80       61       0F       E0       08    IDLE IMMEDIATE
    Error #(32) Contents of registers when command register was written:
     Device state field byte and description:       00 (Unknown)
     Timestamp (lifetime powered-up hours):         1133
     ERROR Register:                                84 (Error: ICRC, ABORT)
     STATUS Register:                               51 (Error: DRDY, DSC, ERR)
     SECTOR Register:                               00
     LBA LOW Register:                              80
     LBA MIDDLE Register:                           61
     LBA HIGH Register:                             0F
     DEVICE Register:                               E0
     Extended error bytes:                          2D 66 46 1B 00 00 03 00 DF 03 04 00 B3 00 00 0B 00 00 0C
     Listing of previous 5 commands executed before error (reverse-sequential):
       Time(secs) Command  Feature   Sector  LBA Low  LBA Mid LBA High   Device  DevCtrl  Command
Description
       ---------  -------  -------   ------  -------  ------- --------   ------  -------
-----------------------
      1467.920       C8       00       08       80       61       0F       E0       08    READ DMA
      1467.856       C8       00       10       80       48       54       E2       08    READ DMA
      1467.824       C8       00       08       3F       00       00       E0       08    READ DMA
      1467.760       C8       00       10       BF       60       0F       E0       08    READ DMA
      1467.696       C8       00       10       BF       60       0F       E0       08    READ DMA
    Error #(31) Contents of registers when command register was written:
     Device state field byte and description:       00 (Unknown)
     Timestamp (lifetime powered-up hours):         1133
     ERROR Register:                                84 (Error: ICRC, ABORT)
     STATUS Register:                               51 (Error: DRDY, DSC, ERR)
     SECTOR Register:                               00
     LBA LOW Register:                              BF
     LBA MIDDLE Register:                           60
     LBA HIGH Register:                             0F
     DEVICE Register:                               E0
     Extended error bytes:                          3D 65 46 1B 00 00 03 00 5E 03 07 00 17 04 00 0B 00 00 0C
     Listing of previous 5 commands executed before error (reverse-sequential):
       Time(secs) Command  Feature   Sector  LBA Low  LBA Mid LBA High   Device  DevCtrl  Command
Description
       ---------  -------  -------   ------  -------  ------- --------   ------  -------
-----------------------
      1467.696       C8       00       10       BF       60       0F       E0       08    READ DMA
       907.376       C8       00       20       08       00       00       E0       08    READ DMA
       907.280       E1       00       00       00       00       00       E0       08    IDLE IMMEDIATE
       907.216       C8       00       08       00       00       00       E0       08    READ DMA
       902.432       B0       D1       01       01       4F       C2       E0       08    SMART READ
ATTRIBUTE THRESHOLDS
    Error #(30) Contents of registers when command register was written:
     Device state field byte and description:       00 (Unknown)
     Timestamp (lifetime powered-up hours):         1132
     ERROR Register:                                84 (Error: ICRC, ABORT)
     STATUS Register:                               51 (Error: DRDY, DSC, ERR)
     SECTOR Register:                               00
     LBA LOW Register:                              00
     LBA MIDDLE Register:                           00
     LBA HIGH Register:                             00
     DEVICE Register:                               E0
     Extended error bytes:                          DC D7 3D 1B 00 00 03 00 5E 03 07 00 00 00 00 0B 00 00 0C
     Listing of previous 5 commands executed before error (reverse-sequential):
       Time(secs) Command  Feature   Sector  LBA Low  LBA Mid LBA High   Device  DevCtrl  Command
Description
       ---------  -------  -------   ------  -------  ------- --------   ------  -------
-----------------------
       907.216       C8       00       08       00       00       00       E0       08    READ DMA
       902.432       B0       D1       01       01       4F       C2       E0       08    SMART READ
ATTRIBUTE THRESHOLDS
       902.384       B0       D0       01       00       4F       C2       E0       08    SMART READ DATA
       902.336       B0       D8       00       01       4F       C2       E0       08    SMART ENABLE
OPERATIONS
       823.680       C4       00       20       08       00       00       E0       08    READ MULTIPLE
  Note:  All ATA registers represented by single HEX byte. The timestamp represents the elapsed
    time in seconds since previous power=on. This wraps back to zero approximately every 50 days because
that
    represents 2 ^ 32 milliseconds. Only the last 5 errors are retained by the disk drive per ANSI
```

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```
specification.

Discovered MYLEX DACARMRB S/N "0002ab5c20000080e511ab5c0000000000000000" on /dev/sda (SMART
unsupported)(69423 MB)

Discovered MYLEX DACARMRB PSEUDO S/N " " on /dev/sdb

Program Ended.
```

Analysis: Both of these drives have been used in a system for a significantly longer time, and you see they have all recorded errors. In the case of the Maxtor disk, you will see that there are also extended error bytes which are vendor-unique.

Notes:

- The **-O** option may be added to the command-line with other options. If the **-O** option is used, however, the program will automatically terminate after reporting all relevant information. The program will not launch and run in the background after discovering the devices.
- The **-O** option will only report information if the selected device is capable of reporting such information. Disks that do not support the SMART Report Error Log will ignore the command.
- The **-O** option reports really advanced stuff. Many of the "errors" it reports may be perfectly normal. SANtools does not interpret this information for you, but your hardware and/or disk drive vendor or supplier should be able to analyze the information for you, provided you are having some sort of problem. If you are a storage engineer, however, you will find this feature invaluable.
- The **-O** option can be combined with other reporting options such as **-I** 54 or **-S** 72.
- This function works with SPARC Solaris, Windows family operating system, LINUX, and OS X.

1.24 Enabling, Disabling, Controlling S.M.A.R.T

Enabling S.M.A.R.T. Polling

SMARTMon-UX enables S.M.A.R.T. polling by default. If you invoke the program with no options at all, the program will scan for all disk drives, enable S.M.A.R.T. as each disk is discovered, and relaunch into the background after information has been reported. Details for each operating system is described with additional details in the Principles of Operation 3 section.

If you are running a Windows-family O/S, the MS-DOS box will stay open and the program will continue to run in that window. That is because the O/S does not provide a convenient method to run a command-line program as a background job.

Turning off S.M.A.R.T.

With version 1.23, we added a new command option, **-p**. This command option searches for all SCSI & fibre channel disks, checks to see if S.M.A.R.T. is turned on, and disables it. When all of the devices have been scanned, it exists the program. The **-p** option also reports what state that S.M.A.R.T. was in for the selected disks as they are discovered.

Example: `./smartmon-ux -p /dev/sga /dev/sgb` (Disables S.M.A.R.T. for these two disks)
`./smartmon-ux -p` (Disables S.M.A.R.T. for all disks)

(Substitute **-pp** for **-p** in commands above to make the change non-volatile, so S.M.A.R.T. stays off even after recycling power).

Notes:

Enabling S.M.A.R.T. for SCSI and Fibre Channel disks requires making a change to mode page 1C. Per the S.M.A.R.T. specification, we do not make the change permanent by programming the device using the saved 80 mode page. We only modify the current 80 mode page 79. That means once you recycle power on your disk drives, the disk will revert to whatever state it was in before invoking SMARTMon-UX.

If you wish to permanently configure your disk so that S.M.A.R.T. is always enabled (or disabled) at power-on, you will need to make appropriate changes to the disk's mode page using the mode page editor function. This can be done by

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using either the **-mpimport** 98 or **-B** 79 commands.

As always, never make changes to mode pages unless you know what you are doing. We suggest that if you want to disable S.M.A.R.T., use the new **-p** command described in this section. If you want to disable S.M.A.R.T., so it stays disabled, even after power cycles, then use the **-pp** command.

You should also look at the **Mode Page 1C settings** 228 which provide more information on these and related topics.

1.25 Mode Page Editor

This is one of the most valuable components of S.M.A.R.T. Disk Monitor. It allows you to change hundreds of disk drive settings covering diverse features such as how the drive formats, power-saving settings, error-recovery algorithms, and read-write cache settings.

First and foremost ...
If you have no concept of what a mode page editor is, or what it can do for you, then look but do not touch. In extreme cases making incorrect changes can make your data inaccessible or result in data loss.

You should ***always consult with your hardware vendor*** to make sure any mode changes you make do not cause a problem and would be supportable. If you purchased your disk drives as part of an integrated system (particularly from Sun, HP, or SGI), the mode pages will typically be correct. They may, however, not be optimal for your hardware configuration. There are over a dozen configurable cache-related settings. By tweaking these values you may improve performance considerably.

If you purchased 3rd party disk drives, the mode pages will probably be incorrect. IBM, SUN, and HP may all integrate the same physical disk drive, but they have very different mode page settings for the error recovery and cache control pages.

For example, Seagate disks typically ship with write cache enabled, which will cause data loss if your system loses power. Sun and HP disks typically ship with write cache disabled for your protection.

To view all the mode pages for a particular device, enter:

```
/etc/smartmon-ux -A /hw/scsi/sc0d1l0
```

This might report something like:

```
SMARTMon-ux [Release 1.04, Build 27-SEP-2001] - Copyright 2001 SANtools, Inc. http://www.SANtools.com
Discovered SEAGATE ST39175LC S/N "3AL07K7P" on /hw/scsi/sc0d1l0 (S.M.A.R.T. enabled)

Page 00h Current:
0000: 80 02 07 00                                       ....
Page 00h Changeable:
0000: 80 02 77 40                                       ..w@
Page 00h Default:
0000: 80 02 00 00                                       ....
Page 00h Saved:
0000: 80 02 07 00                                       ....

Page 01h Current:
0000: 81 0A C4 0B E8 00 00 00 0F 00 FF FF               ............
Page 01h Changeable:
0000: 81 0A FF FF 00 00 00 00 FF 00 FF FF               ............
Page 01h Default:
0000: 81 0A C0 0B E8 00 00 00 0F 00 FF FF               ............
Page 01h Saved:
0000: 81 0A C4 0B E8 00 00 00 0F 00 FF FF               ............
       .
       .
       .
Page 1Ch Current:
0000: 9C 0A 00 04 00 00 17 70 00 00 00 00               .......p....
Page 1Ch Changeable:
```

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```
0000: 9C 0A 8D 0F FF FF FF FF FF FF FF FF            ............
Page 1Ch Default:
0000: 9C 0A 00 00 00 00 00 00 00 00 01               ............
Page 1Ch Saved:
0000: 9C 0A 08 00 00 00 00 00 00 00 01               ............
Terminating program.
```

If you then wanted to make a change to the saved page 1C, you might enter something like
`/etc/smartmon-ux -B S,9C,0A,08,00,00,00,00,00,FF,FF,FF,FF /hw/scsi/sc0d1l0`

Current, **Saved**, **Default** and **Changeable Pages** refer to the Page Control bits, which determine which set of values are desired. Basically consider the default settings are factory settings, and saved settings are the result of any changes that have been "saved" through SMARTMon-UX, or any other program which made a change to a particular mode page. If you make a change and specify it should be made to the **saved** 80 page, that change will also be reflected into the **current** 80 page.

Not all bits on all mode pages are changeable. Also, is it quite common for firmware upgrades to change changeable or default bits in particular mode pages. Furthermore, you might not be able to make any changes to a particular mode page for a particular device.

This manual does not contain the record layout and meanings of mode pages. This information is typically available from your disk manufacturer's web site, as a good portion of the pages are drive-specific.

Note also that mode pages are not unique to disk drives. They are unique, however to SCSI & Fibre channel devices. Tapes, CDROMs, disks, and some SES enclosures have mode pages.

If you have multiple mode pages to change, or want to clone some or all mode pages to more than one peripheral of the same type, you should use the **-mpimport** 98 and **-mpexport** 95 functions found in the Batch Mode Page Import/Export 95 section.

1.26 Mode Page Viewer

The viewer, invoked by the **-J** option, displays most of the ANSI-defined mode pages in human readable format. The ANSI specification defines hundreds of mode page settings. Some fields are optional, and some are required depending on what type of device you have, and what ANSI specification level it is.

The **-A** option will instruct the software to report full hex dumps of all mode pages 79,

You can download one of the ANSI specification at: ftp://ftp.t10.org/t10/drafts/spc3/spc3r05.pdf. It has full information about interpreting the hundreds of bytes, bits, and bit fields found in SCSI peripherals. In the interest of enticing you to download the spec, we will discuss a small subset of the information we are learning about one of the Seagate disk drives attached to a development system. Revisions are constantly changing, and the link will expire some time in the future. If you just go to the http://www.t10.org site, then you will be able to view all of the documents.

Below are some sample outputs from a disk drive and a tape drive.

```
SMARTMon-ux [Release 1.10F, Build 22-APR-2002] - Copyright 2002 SANtools, Inc. http://www.SANtools.com
Discovered SEAGATE ST373307LC S/N "3HZ0381E" on /dev/sda (SMART enabled)(70007 MB)
 Read-Write Error Recovery               : Page [01h] (Factory, Current, Saved)
  Automatic reallocation of write (AWRE) : 1, 1, 1
  Automatic reallocation of read (ARRE)  : 1, 1, 1
  Transfer block (TB)                    : 0, 0, 0
  Read continuous (RC)                   : 0, 0, 0
  Post error (PER)                       : 0, 0, 0
  Disable transfer on error (DTE)        : 0, 0, 0
  Disable correction (DCR)               : 0, 0, 0
```

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```
 Read Retry Count                        : 11, 11, 11
 Correction Span                         : 255, 255, 255 {R/O}
 Head Offset Count                       : 0, 0, 0 {R/O}
 Data Strobe Offset Count                : 0, 0, 0 {R/O}
 Write Retry Count                       : 5, 5, 5
 Recovery Time Limit                     : 65535, 65535, 65535

Disconnect-Reconnect                     : Page [02h] (Factory, Current, Saved)
 Buffer full ratio                       : 128, 128, 128
 Buffer empty ratio                      : 128, 128, 128
 Bus inactivity limit                    : 10, 10, 10 {R/O}
 Disconnect time limit                   : 0, 0, 0 {R/O}
 Connect time limit                      : 0, 0, 0 {R/O}
 Maximum burst size                      : 0, 0, 0 {R/O}
 Enable modify data pointers (EMDP)      : 0, 0, 0
 Fair arbitration                        : 0, 0, 0 {R/O}
 Disconnect immediate (DImm)             : 0, 0, 0 {R/O}
 Data transfer disconnect control (DTDC) : 0, 0, 0
 First burst size                        : 0, 0, 0 {R/O}

Format Device                            : Page [03h] (Factory, Current, Saved)
 Tracks per zone                         : 9044, 9044, 9044 {R/O}
 Alternate sectors per zone              : 0, 0, 0 {R/O}
 Alternate tracks per zone               : 16, 16, 16 {R/O}
 Alternate tracks per lun                : 0, 0, 0 {R/O}
 Sectors per track                       : 720, 720, 720 {R/O}
 Bytes per sector                        : 512, 512, 512 {R/O}
 Interleave                              : 1, 1, 1 {R/O}
 Track skew factor                       : 144, 144, 144 {R/O}
 Cylinder skew factor                    : 102, 102, 102 {R/O}
 Supports soft sectoring (SSEC)          : 0, 0, 0 {R/O}
 Supports hard sectoring (SHEC)          : 1, 1, 1 {R/O}
 Removable Medium (RMB)                  : 0, 0, 0 {R/O}
 Addresses assigned by surface (SURF)    : 0, 0, 0 {R/O}

Rigid Disk Device Geometry               : Page [04h] (Factory, Current, Saved)
 Number of cylinders                     : 49855, 49855, 49855 {R/O}
 Number of heads                         : 4, 4, 4 {R/O}
 Starting write precomp                  : 0, 0, 0 {R/O}
 Starting reduced current                : 0, 0, 0 {R/O}
 Drive step rate                         : 0, 0, 0 {R/O}
 Landing Zone Cylinder                   : 0, 0, 0 {R/O}
 RPL                                     : 0, 0, 0 {R/O}
 Rotational Offset                       : 0, 0, 0 {R/O}
 Medium rotation Rate                    : 10033, 10033, 10033 {R/O}

Verify Error Recovery                    : Page [07h] (Factory, Current, Saved)
 EER                                     : 0, 0, 0
 PER                                     : 0, 0, 0
 DTE                                     : 0, 0, 0
 DCR                                     : 0, 0, 0
 Verify Retry Count                      : 11, 11, 11
 Verify Correction Span (bits)           : 255, 255, 255 {R/O}
 Verify Recovery Time Limit (ms)         : 65535, 65535, 65535

Cache Control                            : Page [08h] (Factory, Current, Saved)
 Initiator control (IC)                  : 0, 0, 0
 Abort Pre-fetch (ABPF)                  : 0, 0, 0 {R/O}
 Caching analysis permitted (CAP)        : 0, 0, 0
 Discontinuity (DISC)                    : 1, 1, 1
 Size enable (Size)                      : 0, 0, 0 {R/O}
 Write cache enable (WCE)                : 1, 1, 1
 Multiplication factor (MF)              : 0, 0, 0 {R/O}
 Read cache disable (RCD)                : 0, 0, 0
 Demand read retention priority          : 0, 0, 0 {R/O}
 Demand Write Retention Priority         : 0, 0, 0 {R/O}
 Disable Pre-fetch Transfer Length       : 65535, 65535, 65535 {R/O}
 Minimum Pre-fetch                       : 0, 0, 0
 Maximum Pre-fetch                       : 65535, 65535, 65535
 Maximum Pre-fetch Ceiling               : 65535, 65535, 65535 {R/O}
 Force sequential write (FSW)            : 0, 0, 0
```

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```
 LB cache segment size (LBCSS)          : 0, 0, 0 {R/O}
 Disable read-ahead (DRA)               : 0, 0, 0
 Vendor-specific bits (VSS)             : 0, 0, 0 {R/O}
 Number of cache segments               : 32, 32, 32
 Cache segment size                     : 0, 0, 0 {R/O}
 Non cache segment size                 : 0, 0, 0 {R/O}

Control Mode                            : Page [0Ah] (Factory, Current, Saved)
 TST                                    : 0, 0, 0 {R/O}
 D_SENSE                                : 0, 0, 0 {R/O}
 GLTSD                                  : 1, 1, 1
 RLEC                                   : 0, 0, 0
 Queue algorithm modifier               : 0, 0, 0
 QErr                                   : 0, 0, 0 {R/O}
 DQue                                   : 0, 0, 0
 TAS                                    : 0, 0, 0 {R/O}
 RAQ                                    : 0, 0, 0 {R/O}
 UA_INTLCK_CTRL                         : 0, 0, 0 {R/O}
 SWP                                    : 0, 0, 0 {R/O}
 RAERP                                  : 0, 0, 0 {R/O}
 UUAERP                                 : 0, 0, 0 {R/O}
 EAERP                                  : 0, 0, 0 {R/O}
 Autoload mode                          : 0, 0, 0 {R/O}
 Ready AER holdoff period               : 0, 0, 0 {R/O}
 Busy timeout period                    : 0, 0, 0 {R/O}
 Extended self-test completion time     : 1488, 1488, 1488 {R/O}

Protocol Specific Port                  : Page [19h] (Factory, Current, Saved)
 Physical interface                     : Parallel SCSI
 Driver strength                        : 0, 0, 0 {R/O}
 Driver asymmetry                       : 0, 0, 0 {R/O}
 Driver precompensation                 : 0, 0, 0 {R/O}
 Driver slew rate                       : 1, 1, 1 {R/O}
 DB(0) Value                            : 0, 0, 0 {R/O}
 DB(1) Value                            : 0, 0, 0 {R/O}
 DB(2) Value                            : 0, 0, 0 {R/O}
 DB(3) Value                            : 0, 0, 0 {R/O}
 DB(4) Value                            : 0, 0, 0 {R/O}
 DB(5) Value                            : 0, 0, 0 {R/O}
 DB(6) Value                            : 0, 0, 0 {R/O}
 DB(7) Value                            : 0, 0, 0 {R/O}
 DB(8) Value                            : 0, 0, 0 {R/O}
 DB(9) Value                            : 0, 0, 0 {R/O}
 DB(10) Value                           : 0, 0, 0 {R/O}
 DB(11) Value                           : 0, 0, 0 {R/O}
 DB(12) Value                           : 0, 0, 0 {R/O}
 DB(13) Value                           : 0, 0, 0 {R/O}
 DB(14) Value                           : 0, 0, 0 {R/O}
 P_CRCA                                 : 0, 0, 0 {R/O}
 P1                                     : 0, 0, 0 {R/O}
 BSY                                    : 0, 0, 0 {R/O}
 SEL                                    : 0, 0, 0 {R/O}
 RST                                    : 0, 0, 0 {R/O}
 REQ                                    : 0, 0, 0 {R/O}
 ACK                                    : 0, 0, 0 {R/O}
 ATN                                    : 0, 0, 0 {R/O}
 C/D                                    : 0, 0, 0 {R/O}
 I/O                                    : 0, 0, 0 {R/O}
 MSG                                    : 0, 0, 0 {R/O}
 Transfer period factor                 : 0, 0, 0 {R/O}
 REQ/ACK offset timing                  : 0, 0, 0 {R/O}
 Transfer width exponent                : 1, 1, 1 {R/O}
 Protocol options bits                  : 00h, 09h, 00h
 Driver asymmetry                       : 0, 0, 0 {R/O}
 Sent PCOMP enabled                     : 0, 0, 0 {R/O}
 Received PCOMP enabled                 : 1, 1, 1 {R/O}
 Min xfr  period factor                 : 0, 0, 0 {R/O}
 Max REQ/ACK offset                     : 0, 0, 0 {R/O}
 Max transfer width exponent            : 1, 1, 1 {R/O}
 Protocol options bits supported        : 08h, 08h, 08h
```

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```
 Power Condition                          : Page [1Ah] (Factory, Current, Saved)
  Idle                                    : 1, 0, 0
  Standby                                 : 1, 0, 0
  Idle condition timer                    : 00000001h, 00000001h, 00000001h
  Standby condition timer                 : 00000004h, 00000004h, 00000004h

 Informational Exceptions Control         : Page [1Ch] (Factory, Current, Saved)
  PERF                                    : 0, 0, 0
  EBF                                     : 0, 0, 0 {R/O}
  EWASC                                   : 1, 1, 1
  DExcpt                                  : 0, 0, 0
  TEST                                    : 0, 0, 0
  LogErr                                  : 0, 0, 0
  MRIE                                    : 0, 4, 0
  Interval timer                          : 00000000h, 00001770h, 00000000h
  Report count                            : 00000001h, 00000000h, 00000001h

Discovered IBM DNEF-309170 S/N "AJ18Q212" on /dev/sdm [SES] (SMART enabled)(8748 MB)
 Read-Write Error Recovery                : Page [01h] (Factory, Current, Saved)
  Automatic reallocation of write (AWRE)  : 1, 1, 1
  Automatic reallocation of read (ARRE)   : 1, 1, 1
  Transfer block (TB)                     : 0, 0, 0
  Read continuous (RC)                    : 0, 0, 0
  Post error (PER)                        : 0, 0, 0
  Disable transfer on error (DTE)         : 0, 0, 0
  Disable correction (DCR)                : 0, 0, 0
  Read Retry Count                        : 1, 1, 1
  Correction Span                         : 0, 0, 0
  Head Offset Count                       : 0, 0, 0 {R/O}
  Data Strobe Offset Count                : 0, 0, 0 {R/O}
  Write Retry Count                       : 1, 1, 1
  Recovery Time Limit                     : 0, 0, 0

 Disconnect-Reconnect                     : Page [02h] (Factory, Current, Saved)
  Buffer full ratio                       : 0, 0, 0
  Buffer empty ratio                      : 0, 0, 0
  Bus inactivity limit                    : 0, 0, 0 {R/O}
  Disconnect time limit                   : 0, 0, 0 {R/O}
  Connect time limit                      : 0, 0, 0 {R/O}
  Maximum burst size                      : 0, 0, 0
  Enable modify data pointers (EMDP)      : 0, 0, 0 {R/O}
  Fair arbitration                        : 0, 0, 0 {R/O}
  Disconnect immediate (DImm)             : 0, 0, 0
  Data transfer disconnect control (DTDC) : 0, 0, 0 {R/O}
  First burst size                        : 0, 0, 0 {R/O}

 Format Device                            : Page [03h] (Factory, Current, Saved)
  Tracks per zone                         : 4900, 4900, 4900 {R/O}
  Alternate sectors per zone              : 0, 0, 0 {R/O}
  Alternate tracks per zone               : 0, 0, 0 {R/O}
  Alternate tracks per lun                : 0, 0, 0 {R/O}
  Sectors per track                       : 364, 364, 364 {R/O}
  Bytes per sector                        : 512, 512, 512 {R/O}
  Interleave                              : 1, 1, 1 {R/O}
  Track skew factor                       : 11, 11, 11 {R/O}
  Cylinder skew factor                    : 20, 20, 20 {R/O}
  Supports soft sectoring (SSEC)          : 0, 0, 0 {R/O}
  Supports hard sectoring (SHEC)          : 1, 1, 1 {R/O}
  Removable Medium (RMB)                  : 0, 0, 0 {R/O}
  Addresses assigned by surface (SURF)    : 0, 0, 0 {R/O}

 Rigid Disk Device Geometry               : Page [04h] (Factory, Current, Saved)
  Number of cylinders                     : 11474, 11474, 11474 {R/O}
  Number of heads                         : 5, 5, 5 {R/O}
  Starting write precomp                  : 0, 0, 0 {R/O}
  Starting reduced current                : 0, 0, 0 {R/O}
  Drive step rate                         : 0, 0, 0 {R/O}
  Landing Zone Cylinder                   : 0, 0, 0 {R/O}
  RPL                                     : 0, 0, 0 {R/O}
  Rotational Offset                       : 0, 0, 0 {R/O}
  Medium rotation Rate                    : 7200, 7200, 7200 {R/O}
```

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```
Verify Error Recovery                   : Page [07h] (Factory, Current, Saved)
 EER                                    : 0, 0, 0 {R/O}
 PER                                    : 0, 0, 0
 DTE                                    : 0, 0, 0 {R/O}
 DCR                                    : 0, 0, 0
 Verify Retry Count                     : 1, 1, 1
 Verify Correction Span (bits)          : 0, 0, 0
 Verify Recovery Time Limit (ms)        : 0, 0, 0

Cache Control                           : Page [08h] (Factory, Current, Saved)
 Initiator control (IC)                 : 0, 0, 0
 Abort Pre-fetch (ABPF)                 : 0, 0, 0
 Caching analysis permitted (CAP)       : 0, 0, 0
 Discontinuity (DISC)                   : 0, 0, 0
 Size enable (Size)                     : 0, 0, 0
 Write cache enable (WCE)               : 0, 0, 0
 Multiplication factor (MF)             : 0, 0, 0
 Read cache disable (RCD)               : 0, 0, 0
 Demand read retention priority         : 0, 0, 0
 Demand Write Retention Priority        : 0, 0, 0
 Disable Pre-fetch Transfer Length      : 65535, 65535, 65535
 Minimum Pre-fetch                      : 0, 0, 0
 Maximum Pre-fetch                      : 65535, 65535, 65535
 Maximum Pre-fetch Ceiling              : 65535, 65535, 65535
 Force sequential write (FSW)           : 0, 0, 0
 LB cache segment size (LBCSS)          : 0, 0, 0
 Disable read-ahead (DRA)               : 0, 0, 0
 Vendor-specific bits (VSS)             : 0, 0, 0 {R/O}
 Number of cache segments               : 14, 14, 14 {R/O}
 Cache segment size                     : 0, 0, 0
 Non cache segment size                 : 0, 0, 0

Control Mode                            : Page [0Ah] (Factory, Current, Saved)
 TST                                    : 0, 0, 0 {R/O}
 D_SENSE                                : 0, 0, 0 {R/O}
 GLTSD                                  : 0, 0, 0 {R/O}
 RLEC                                   : 0, 0, 0 {R/O}
 Queue algorithm modifier               : 0, 0, 0
 QErr                                   : 0, 0, 0 {R/O}
 DQue                                   : 0, 0, 0
 TAS                                    : 0, 0, 0 {R/O}
 RAQ                                    : 0, 0, 0 {R/O}
 UA_INTLCK_CTRL                         : 0, 0, 0 {R/O}
 SWP                                    : 0, 0, 0 {R/O}
 RAERP                                  : 0, 0, 0 {R/O}
 UUAERP                                 : 0, 0, 0 {R/O}
 EAERP                                  : 0, 0, 0 {R/O}
 Autoload mode                          : 0, 0, 0 {R/O}
 Ready AER holdoff period               : 0, 0, 0
 Busy timeout period                    : 0, 0, 0
 Extended self-test completion time     : 0, 0, 0 {R/O}

Notch and Partition                     : Page [0Ch] (Factory, Current, Saved)
 Notched Drive (ND)                     : 1, 1, 1 {R/O}
 Logical or Physical Notch (LPN)        : 0, 0, 0 {R/O}
 Max # of notches                       : 11, 11, 11 {R/O}
 Active Notch                           : 0, 0, 0 {R/O}
 Starting Boundary                      : 00000000h, 00000000h, 00000000h
 Ending Boundary                        : 002CD104h, 002CD104h, 002CD104h
 Pages notched                          : 000000000000100Ch, 000000000000100Ch, 000000000000100Ch

XOR Control                             : Page [10h] (Factory, Current, Saved)
 XORDIS                                 : 1, 1, 1
 Maximum XOR write size                 : 00000080h, 00000080h, 00000080h
 Maximum regenerate size                : 00000080h, 00000080h, 00000080h
 Maximum rebuild read size              : 00000080h, 00000080h, 00000080h
 Rebuild delay                          : 0, 0, 0

Power Condition                         : Page [1Ah] (Factory, Current, Saved)
 Idle                                   : 0, 0, 0
```

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```
  Standby                                 : 0, 0, 0
  Idle condition timer                    : 00000000h, 00000000h, 00000000h
  Standby condition timer                 : 00000000h, 00000000h, 00000000h

 Informational Exceptions Control         : Page [1Ch] (Factory, Current, Saved)
  PERF                                    : 0, 0, 0
  EBF                                     : 0, 0, 0 {R/O}
  EWASC                                   : 0, 1, 0
  DExcpt                                  : 0, 0, 0
  TEST                                    : 0, 0, 0
  LogErr                                  : 0, 0, 0
  MRIE                                    : 0, 4, 3
  Interval timer                          : 00000000h, 00001770h, 00000000h
  Report count                            : 00000000h, 00000000h, 00000001h
Discovered SONY SDT-5200 S/N " " on /dev/st0 (tape)
 Disconnect-Reconnect                     : Page [02h] (Current)
  Buffer full ratio                       : 0 {R/O}
  Buffer empty ratio                      : 0 {R/O}
  Bus inactivity limit                    : 0 {R/O}
  Disconnect time limit                   : 0
  Connect time limit                      : 0 {R/O}
  Maximum burst size                      : 494
  Enable modify data pointers (EMDP)      : 0 {R/O}
  Fair arbitration                        : 0 {R/O}
  Disconnect immediate (DImm)             : 0 {R/O}
  Data transfer disconnect control (DTDC) : 0 {R/O}
  First burst size                        : 0 {R/O}

 Data Compression                         : Page [0Fh] (Current)
  DCE                                     : 0 {R/O}
  DCC                                     : 0 {R/O}
  DDE                                     : 0 {R/O}
  RED                                     : 0 {R/O}
  Compression algorithm                   : 00000000h
  Decompression algorithm                 : 00000000h

 Tape Control                             : Page [10h] (Current)
  Change active partition (CAP)           : 0
  Change active format (CAF)              : 0
  Active format                           : 8
  Active partition                        : 0 {R/O}
  Write buffer full ratio                 : 0 {R/O}
  Read buffer empty ratio                 : 0 {R/O}
  Write delay time                        : 45
  Data buffer recovery (DBR)              : 0 {R/O}
  Block identifiers supported (BIS)       : 1 {R/O}
  Report setmarks (RSMK)                  : 1
  Automatic velocity control (AVC)        : 0 {R/O}
  Stop on consecutive filemarks (SOCF)    : 0 {R/O}
  Recover buffer over (RBO)               : 0 {R/O}
  Recover error warning (REW)             : 0 {R/O}
  Gap size                                : 0 {R/O}
  EOD Defined                             : 0 {R/O}
  Enable EOD generation (EEG)             : 1 {R/O}
  Synchronize early warning (SEW)         : 1 {R/O}
  Soft write protect (SWP)                : 0 {R/O}
  Buffer size at early warning            : 000000h
  Data compression algorithm              : 00h
  Associated write protect (ASOCWP)       : 0 {R/O}
  Persistent write protect (PERSWP)       : 0 {R/O}
  Permanent write protect (PRMWP)         : 0 {R/O}

 Medium Partition                         : Page [11h] (Current)
  Maximum additional partitions           : 1 {R/O}
  Additional partitions defined           : 0 {R/O}
  Fixed data partitions (FDP)             : 0 {R/O}
  Select data partitions (SDP)            : 0 {R/O}
  Initiator-defined partitions (IDP)      : 0 {R/O}
  Partition size unit-of-measure (PSUM)   : 2 {R/O}
  Partition on format (POFM)              : 0 {R/O}
  CLEAR                                   : 0 {R/O}
```

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```
  ADDP                                  : 0 {R/O}
  Medium format recognition             : 03h
  Partition Units                       : 0 {R/O}

Terminating program.
```

For comparison, this is part of what a Seagate FC disk drive returned for the protocol-specific mode page 19 as shown from
the output for version 1.35 of the software.

```
 Protocol Specific Port                 : Page [19h] (Factory, Current, Saved)
  Physical interface                    : Fibre Channel
  Disable target orig loopid (DTOLI)    : 1, 1, 1
  Disable target init porten (DTIPE)    : 0, 0, 0
  Allow login w/o loop init (ALWLI)     : 1, 1, 1
  Require hard address (RHA)            : 1, 1, 1
  Disable loop master (DLM)             : 1, 1, 1
  Disable discovery (DDIS)              : 0, 0, 0
  Prevent loop port bypass (PLPB)       : 0, 0, 0
  Disable fabric discovery (DTFD)       : 0, 0, 0
  Resource recov timeout granularity    : 0, 0, 0 {R/O}
  Resource recovery timeout             : 0, 0, 0 {R/O}
```

1.26.1 Example Mode Page Dump - SAS Disk

The results below were run under SPARC Solaris 10 using a Seagate ST3146855SS SAS disk.

```
# /etc/smartmon-ux -J /dev/rdsk/c4t17d0s0
SMARTMon-UX [Release 1.36, Build  8-JUN-2008] - Copyright 2001-2008 SANtools(R), Inc. http://www.SANtools.
com
Discovered SEAGATE ST3146855SS S/N "3LN29QG4" on /dev/rdsk/c4t17d0s0 (SMART enabled)(140014 MB)

 Read-Write Error Recovery              : Page [01h] (Factory, Current, Saved)
  Automatic reallocation of write (AWRE)  : 1, 1, 1
  Automatic reallocation of read (ARRE)   : 1, 1, 1
  Transfer block (TB)                   : 0, 0, 0
  Read continuous (RC)                  : 0, 0, 0
  Enable early recovery (EER)           : 0, 0, 0
  Post error (PER)                      : 1, 1, 1
  Disable transfer on error (DTE)       : 0, 0, 0
  Disable correction (DCR)              : 0, 0, 0
  Read Retry Count                      : 11, 11, 11
  Correction Span                       : 255, 255, 255 {R/O}
  Head Offset Count                     : 0, 0, 0 {R/O}
  Data Strobe Offset Count              : 0, 0, 0 {R/O}
  Write Retry Count                     : 5, 5, 5
  Recovery Time Limit                   : 65535, 65535, 65535

 Disconnect-Reconnect                   : Page [02h] (Factory, Current, Saved)
  Buffer full ratio                     : 0, 0, 0 {R/O}
  Buffer empty ratio                    : 0, 0, 0 {R/O}
  Bus inactivity limit                  : 0, 0, 0 {R/O}
  Disconnect time limit                 : 0, 0, 0 {R/O}
  Connect time limit                    : 0, 0, 0 {R/O}
  Maximum burst size                    : 164, 164, 164
  Enable modify data pointers (EMDP)    : 0, 0, 0 {R/O}
  Fair arbitration                      : 0, 0, 0 {R/O}
  Disconnect immediate (DImm)           : 0, 0, 0 {R/O}
  Data transfer disconnect control (DTDC) : 0, 0, 0 {R/O}
  First burst size                      : 0, 0, 0 {R/O}

 Format Device                          : Page [03h] (Factory, Current, Saved)
  Tracks per zone                       : 13356, 13356, 13356 {R/O}
  Alternate sectors per zone            : 0, 0, 0 {R/O}
  Alternate tracks per zone             : 28, 28, 28 {R/O}
  Alternate tracks per lun              : 0, 0, 0 {R/O}
  Sectors per track                     : 987, 987, 987 {R/O}
  Bytes per sector                      : 512, 512, 512 {R/O}
  Interleave                            : 1, 1, 1 {R/O}
```

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```
 Track skew factor                    : 230, 230, 230 {R/O}
 Cylinder skew factor                 : 170, 170, 170 {R/O}
 Supports soft sectoring (SSEC)       : 0, 0, 0 {R/O}
 Supports hard sectoring (SHEC)       : 1, 1, 1 {R/O}
 Removable Medium (RMB)               : 0, 0, 0 {R/O}
 Addresses assigned by surface (SURF) : 0, 0, 0 {R/O}

Rigid Disk Device Geometry            : Page [04h] (Factory, Current, Saved)
 Number of cylinders                  : 74340, 74340, 74340 {R/O}
 Number of heads                      : 4, 4, 4 {R/O}
 Starting write precomp               : 0, 0, 0 {R/O}
 Starting reduced current             : 0, 0, 0 {R/O}
 Drive step rate                      : 0, 0, 0 {R/O}
 Landing Zone Cylinder                : 0, 0, 0 {R/O}
 RPL                                  : 0, 0, 0 {R/O}
 Rotational Offset                    : 0, 0, 0 {R/O}
 Medium rotation Rate                 : 15015, 15015, 15015 {R/O}

Verify Error Recovery                 : Page [07h] (Factory, Current, Saved)
 EER                                  : 0, 0, 0
 PER                                  : 1, 1, 1
 DTE                                  : 0, 0, 0
 DCR                                  : 0, 0, 0
 Verify Retry Count                   : 11, 11, 11
 Verify Correction Span (bits)        : 255, 255, 255 {R/O}
 Verify Recovery Time Limit (ms)      : 65535, 65535, 65535

Cache Control                         : Page [08h] (Factory, Current, Saved)
 Initiator control (IC)               : 0, 0, 0
 Abort Pre-fetch (ABPF)               : 0, 0, 0 {R/O}
 Caching analysis permitted (CAP)     : 0, 0, 0
 Discontinuity (DISC)                 : 1, 1, 1 {R/O}
 Size enable (Size)                   : 0, 0, 0 {R/O}
 Write cache enable (WCE)             : 0, 1, 1
 Multiplication factor (MF)           : 0, 0, 0 {R/O}
 Read cache disable (RCD)             : 0, 0, 0
 Demand read retention priority       : 0, 0, 0 {R/O}
 Demand Write Retention Priority      : 0, 0, 0 {R/O}
 Disable Pre-fetch Transfer Length    : 65535, 65535, 65535 {R/O}
 Minimum Pre-fetch                    : 0, 0, 0
 Maximum Pre-fetch                    : 65535, 65535, 65535
 Maximum Pre-fetch Ceiling            : 65535, 65535, 65535 {R/O}
 Force sequential write (FSW)         : 1, 1, 1 {R/O}
 LB cache segment size (LBCSS)        : 0, 0, 0 {R/O}
 Disable read-ahead (DRA)             : 0, 0, 0
 Vendor-specific bits (VSS)           : 0, 0, 0 {R/O}
 Number of cache segments             : 32, 32, 32 {R/O}
 Cache segment size                   : 0, 0, 0 {R/O}
 Non cache segment size               : 0, 0, 0 {R/O}

Control Mode                          : Page [0Ah] (Factory, Current, Saved)
 TST                                  : 0, 0, 0 {R/O}
 TMF_ONLY                             : 0, 0, 0 {R/O}
 D_SENSE                              : 0, 0, 0 {R/O}
 GLTSD                                : 0, 0, 0
 RLEC                                 : 1, 1, 1
 Queue algorithm modifier             : 0, 0, 0
 QErr                                 : 0, 0, 0 {R/O}
 DQue                                 : 0, 0, 0 {R/O}
 VS                                   : 0, 0, 0 {R/O}
 RAQ                                  : 0, 0, 0 {R/O}
 UA_INTLCK_CTRL                       : 0, 0, 0 {R/O}
 SWP                                  : 0, 0, 0 {R/O}
 RAERP                                : 0, 0, 0 {R/O}
 UUAERP                               : 0, 0, 0 {R/O}
 EAERP                                : 0, 0, 0 {R/O}
 ATO                                  : 0, 0, 0 {R/O}
 TAS                                  : 0, 0, 0 {R/O}
 Autoload mode                        : 0, 0, 0 {R/O}
 Ready AER holdoff period             : 0, 0, 0 {R/O}
 Busy timeout period                  : 0, 0, 0 {R/O}
```

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```
 Extended self-test completion time      : 0, 0, 0

Protocol                                 : Page [18h] (Factory, Current, Saved)
 Physical interface                      : SAS Serial SCSI
 Transport layer retries                 : 0, 0, 0 {R/O}

Protocol Specific Port                   : Page [19h] (Factory, Current, Saved)
 Physical interface                      : SAS Serial SCSI
 Ready LED meaning                       : 0, 0, 0
 I_T nexus loss time (ms)                : 2000, 2000, 2000
 Initiator response timeout (ms)         : 0, 0, 0


 PHY identifier #0                       : 00h, 00h, 00h
 (0)Attached device type                 : 2, 2, 2 {R/O}
 (0)Negotiated link rate                 : 9, 9, 9 {R/O}
 (0)SSP initiator port #                 : 0, 0, 0 {R/O}
 (0)STP initiator port #                 : 0, 0, 0 {R/O}
 (0)SMP initiator port #                 : 1, 1, 1 {R/O}
 (0)SSP target port #                    : 0, 0, 0 {R/O}
 (0)STP target port #                    : 0, 0, 0 {R/O}
 (0)SMP target port #                    : 1, 1, 1 {R/O}
 (0)SAS Address                          : 5000C5000694BFFDh, 5000C5000694BFFDh, 5000C5000694BFFDh
 (0)Attached SAS address                 : 500A0B82E0894000h, 500A0B82E0894000h, 500A0B82E0894000h
 (0)Attached PHY identifier              : 0Bh, 0Bh, 0Bh
 (0)Prog. min link rate,8=1.5Gbps,9=3Gbps: 8, 8, 8 {R/O}
 (0)Hardw min link rate,8=1.5Gbps,9=3Gbps: 8, 8, 8 {R/O}
 (0)Prog. max link rate,8=1.5Gbps,9=3Gbps: 9, 9, 9 {R/O}
 (0)Hardw max link rate 8=1.5Gbps,9=3Gbps: 9, 9, 9 {R/O}

 PHY identifier #1                       : 01h, 01h, 01h
 (1)Attached device type                 : 2, 2, 2 {R/O}
 (1)Negotiated link rate                 : 9, 9, 9 {R/O}
 (1)SSP initiator port #                 : 0, 0, 0 {R/O}
 (1)STP initiator port #                 : 0, 0, 0 {R/O}
 (1)SMP initiator port #                 : 1, 1, 1 {R/O}
 (1)SSP target port #                    : 0, 0, 0 {R/O}
 (1)STP target port #                    : 0, 0, 0 {R/O}
 (1)SMP target port #                    : 1, 1, 1 {R/O}
 (1)SAS Address                          : 5000C5000694BFFEh, 5000C5000694BFFEh, 5000C5000694BFFEh
 (1)Attached SAS address                 : 500A0B82E0850000h, 500A0B82E0850000h, 500A0B82E0850000h
 (1)Attached PHY identifier              : 0Bh, 0Bh, 0Bh
 (1)Prog. min link rate,8=1.5Gbps,9=3Gbps: 8, 8, 8 {R/O}
 (1)Hardw min link rate,8=1.5Gbps,9=3Gbps: 8, 8, 8 {R/O}
 (1)Prog. max link rate,8=1.5Gbps,9=3Gbps: 9, 9, 9 {R/O}
 (1)Hardw max link rate 8=1.5Gbps,9=3Gbps: 9, 9, 9 {R/O}

Power Condition                          : Page [1Ah] (Factory, Current, Saved)
 Idle                                    : 0, 0, 0
 Standby                                 : 0, 0, 0
 Idle condition timer                    : 00000005h, 00000005h, 00000005h
 Standby condition timer                 : 00000004h, 00000004h, 00000004h

Informational Exceptions Control         : Page [1Ch] (Factory, Current, Saved)
 PERF                                    : 1, 0, 0
 EBF                                     : 0, 0, 0 {R/O}
 EWASC                                   : 1, 1, 1
 DExcpt                                  : 0, 0, 0
 TEST                                    : 0, 0, 0
 EBACKERR                                : 0, 0, 0 {R/O}
 LogErr                                  : 0, 0, 0
 MRIE                                    : 4, 6, 6
 Interval timer                          : 00000000h, 00001770h, 00001770h
 Report count                            : 00000001h, 00000000h, 00000000h

Background scanning configuration       : Page [1Ch,1] (Factory, Current, Saved)
 Bkgrnd suspend on log full (S_L_FULL)   : 0, 0, 0 {R/O}
 Bkgrnd log only intervention (LOWIR)    : 0, 0, 0 {R/O}
 Bkgrnd enable medium scan (EN_BMS)      : 1, 1, 1 {R/O}
 Bkgrnd enable pre-scan (EN_PS)          : 0, 0, 0 {R/O}
 Bkgrnd medium scan interval (hrs)       : 168, 24, 24
```

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```
  Bkgrnd pre-scan time limit (hrs)        : 24, 24, 24
  Bkgrnd min idle time before scan (ms)   : 0, 0, 0 {R/O}
  Bkgrnd max time to suspend scan (ms)    : 0, 0, 0 {R/O}


Program Ended.
```

1.26.2 Example Mode Page Dump - FC Disk

The results below were run under SPARC Solaris 10 using a Seagate ST336704FC Fibre Channel disk.

```
# /etc/smartmon-ux -J /dev/rdsk/c1t2d0s0
SMARTMon-UX [Release 1.36, Build  8-JUN-2008] - Copyright 2001-2008 SANtools(R), Inc. http://www.SANtools.
com
Discovered SEAGATE ST336704FC S/N "3CD0W3AV" on /dev/rdsk/c1t2d0s0 [SES] (SMART enabled)(35003 MB)

 Read-Write Error Recovery               : Page [01h] (Factory, Current, Saved)
  Automatic reallocation of write (AWRE) : 1, 1, 1
  Automatic reallocation of read (ARRE)  : 1, 1, 1
  Transfer block (TB)                    : 0, 1, 1
  Read continuous (RC)                   : 0, 0, 0
  Enable early recovery (EER)            : 0, 0, 0
  Post error (PER)                       : 0, 0, 0
  Disable transfer on error (DTE)        : 0, 0, 0
  Disable correction (DCR)               : 0, 0, 0
  Read Retry Count                       : 11, 11, 11
  Correction Span                        : 240, 240, 240 {R/O}
  Head Offset Count                      : 0, 0, 0 {R/O}
  Data Strobe Offset Count               : 0, 0, 0 {R/O}
  Write Retry Count                      : 5, 5, 5
  Recovery Time Limit                    : 65535, 65535, 65535

 Disconnect-Reconnect                    : Page [02h] (Factory, Current, Saved)
  Buffer full ratio                      : 128, 128, 128
  Buffer empty ratio                     : 128, 128, 128
  Bus inactivity limit                   : 0, 0, 0 {R/O}
  Disconnect time limit                  : 0, 0, 0 {R/O}
  Connect time limit                     : 0, 0, 0 {R/O}
  Maximum burst size                     : 460, 256, 256
  Enable modify data pointers (EMDP)     : 0, 0, 0 {R/O}
  Fair arbitration                       : 0, 0, 0 {R/O}
  Disconnect immediate (DImm)            : 0, 0, 0 {R/O}
  Data transfer disconnect control (DTDC) : 0, 0, 0 {R/O}
  First burst size                       : 0, 0, 0 {R/O}

 Format Device                           : Page [03h] (Factory, Current, Saved)
  Tracks per zone                        : 905, 905, 905 {R/O}
  Alternate sectors per zone             : 0, 0, 0 {R/O}
  Alternate tracks per zone              : 6, 6, 6 {R/O}
  Alternate tracks per lun               : 0, 0, 0 {R/O}
  Sectors per track                      : 424, 424, 424 {R/O}
  Bytes per sector                       : 512, 512, 512 {R/O}
  Interleave                             : 1, 1, 1 {R/O}
  Track skew factor                      : 85, 85, 85 {R/O}
  Cylinder skew factor                   : 90, 90, 90 {R/O}
  Supports soft sectoring (SSEC)         : 0, 0, 0 {R/O}
  Supports hard sectoring (SHEC)         : 1, 1, 1 {R/O}
  Removable Medium (RMB)                 : 0, 0, 0 {R/O}
  Addresses assigned by surface (SURF)   : 0, 0, 0 {R/O}

 Rigid Disk Device Geometry              : Page [04h] (Factory, Current, Saved)
  Number of cylinders                    : 14100, 14100, 14100 {R/O}
  Number of heads                        : 12, 12, 12 {R/O}
  Starting write precomp                 : 0, 0, 0 {R/O}
  Starting reduced current               : 0, 0, 0 {R/O}
  Drive step rate                        : 0, 0, 0 {R/O}
  Landing Zone Cylinder                  : 0, 0, 0 {R/O}
  RPL                                    : 0, 0, 0 {R/O}
  Rotational Offset                      : 0, 0, 0 {R/O}
```

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```
 Medium rotation Rate                    : 10016, 10016, 10016 {R/O}

Verify Error Recovery                    : Page [07h] (Factory, Current, Saved)
 EER                                     : 0, 0, 0
 PER                                     : 0, 0, 0
 DTE                                     : 0, 0, 0
 DCR                                     : 0, 0, 0
 Verify Retry Count                      : 11, 11, 11
 Verify Correction Span (bits)           : 240, 240, 240 {R/O}
 Verify Recovery Time Limit (ms)         : 65535, 65535, 65535

Cache Control                            : Page [08h] (Factory, Current, Saved)
 Initiator control (IC)                  : 0, 0, 0
 Abort Pre-fetch (ABPF)                  : 0, 0, 0 {R/O}
 Caching analysis permitted (CAP)        : 0, 0, 0
 Discontinuity (DISC)                    : 1, 0, 0
 Size enable (Size)                      : 0, 0, 0 {R/O}
 Write cache enable (WCE)                : 1, 1, 1
 Multiplication factor (MF)              : 0, 0, 0 {R/O}
 Read cache disable (RCD)                : 0, 0, 0
 Demand read retention priority          : 0, 0, 0 {R/O}
 Demand Write Retention Priority         : 0, 0, 0 {R/O}
 Disable Pre-fetch Transfer Length       : 65535, 65535, 65535 {R/O}
 Minimum Pre-fetch                       : 0, 0, 0
 Maximum Pre-fetch                       : 65535, 0, 0
 Maximum Pre-fetch Ceiling               : 65535, 65535, 65535 {R/O}
 Force sequential write (FSW)            : 1, 0, 0
 LB cache segment size (LBCSS)           : 0, 0, 0 {R/O}
 Disable read-ahead (DRA)                : 0, 0, 0
 Vendor-specific bits (VSS)              : 0, 0, 0 {R/O}
 Number of cache segments                : 16, 24, 24
 Cache segment size                      : 0, 0, 0 {R/O}
 Non cache segment size                  : 0, 0, 0 {R/O}

Control Mode                             : Page [0Ah] (Factory, Current, Saved)
 TST                                     : 0, 0, 0 {R/O}
 TMF_ONLY                                : 0, 0, 0 {R/O}
 D_SENSE                                 : 0, 0, 0 {R/O}
 GLTSD                                   : 1, 0, 0
 RLEC                                    : 0, 0, 0
 Queue algorithm modifier                : 0, 0, 0
 QErr                                    : 0, 0, 0 {R/O}
 DQue                                    : 0, 0, 0
 VS                                      : 0, 0, 0 {R/O}
 RAQ                                     : 0, 0, 0 {R/O}
 UA_INTLCK_CTRL                          : 0, 0, 0 {R/O}
 SWP                                     : 0, 0, 0
 RAERP                                   : 0, 0, 0 {R/O}
 UUAERP                                  : 0, 0, 0 {R/O}
 EAERP                                   : 0, 0, 0 {R/O}
 ATO                                     : 0, 0, 0 {R/O}
 TAS                                     : 0, 0, 0 {R/O}
 Autoload mode                           : 0, 0, 0 {R/O}
 Ready AER holdoff period                : 0, 0, 0 {R/O}
 Busy timeout period                     : 0, 0, 0 {R/O}
 Extended self-test completion time      : 1350, 1350, 1350 {R/O}

Protocol Specific Port                   : Page [19h] (Factory, Current, Saved)
 Physical interface                      : Fibre Channel
 Disable target orig loopid (DTOLI)      : 0, 0, 0
 Disable target init porten (DTIPE)      : 0, 0, 0
 Allow login w/o loop init (ALWLI)       : 0, 0, 0
 Require hard address (RHA)              : 0, 0, 0
 Disable loop master (DLM)               : 0, 0, 0
 Disable discovery (DDIS)                : 0, 0, 0
 Prevent loop port bypass (PLPB)         : 0, 1, 1
 Disable fabric discovery (DTFD)         : 0, 0, 0
 Resource recov timeout granularity      : 0, 0, 0 {R/O}
 Resource recovery timeout               : 0, 0, 0 {R/O}

Power Condition                          : Page [1Ah] (Factory, Current, Saved)
```

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```
  Idle                                  : 1, 0, 0
  Standby                               : 1, 0, 0
  Idle condition timer                  : 00000001h, 00000001h, 00000001h
  Standby condition timer               : 00000004h, 00000004h, 00000004h

 Informational Exceptions Control       : Page [1Ch] (Factory, Current, Saved)
  PERF                                  : 0, 0, 0
  EBF                                   : 0, 0, 0 {R/O}
  EWASC                                 : 1, 1, 1
  DExcpt                                : 0, 0, 0
  TEST                                  : 0, 0, 0
  EBACKERR                              : 0, 0, 0 {R/O}
  LogErr                                : 0, 0, 0
  MRIE                                  : 0, 6, 6
  Interval timer                        : 00000000h, 00001770h, 00001770h
  Report count                          : 00000001h, 00000000h, 00000000h


Program Ended.
```

This disk does not support any of the background media scanning functions 216 as they are not listed under mode page 1C, where the parameters are specified per the ANSI specification.

1.26.3 Example Mode Page Dump - SCSI Disk

The results below were run under Windows XP using a HP 36 GB SCSI Disk.

```
C>\scratch>smartmon-ux -J \\.\PHYSICALDRIVE1
SMARTMon-UX [Release 1.36, Build  10-JUN-2008] - Copyright 2001-2008 SANtools(R), Inc. http://www.SANtools.
com
Discovered HP 36.4G MAU3036NC S/N "KY010344" on \\.\PHYSICALDRIVE1 (Not Enabling SMART) [Bus/Port/ID.
LUN=0/2/9.0](34732 MB)

 Read-Write Error Recovery              : Page [01h] (Factory, Current, Saved)
  Automatic reallocation of write (AWRE)  : 1, 1, 1
  Automatic reallocation of read (ARRE)   : 1, 1, 1
  Transfer block (TB)                   : 0, 0, 0
  Read continuous (RC)                  : 0, 0, 0
  Enable early recovery (EER)           : 0, 0, 0
  Post error (PER)                      : 0, 0, 0
  Disable transfer on error (DTE)       : 0, 0, 0
  Disable correction (DCR)              : 0, 0, 0
  Read Retry Count                      : 63, 63, 63
  Correction Span                       : 255, 255, 255 {R/O}
  Head Offset Count                     : 0, 0, 0 {R/O}
  Data Strobe Offset Count              : 0, 0, 0 {R/O}
  Write Retry Count                     : 63, 63, 63
  Recovery Time Limit                   : 30000, 30000, 30000

 Disconnect-Reconnect                   : Page [02h] (Factory, Current, Saved)
  Buffer full ratio                     : 0, 0, 0
  Buffer empty ratio                    : 0, 0, 0
  Bus inactivity limit                  : 1, 1, 1 {R/O}
  Disconnect time limit                 : 0, 0, 0 {R/O}
  Connect time limit                    : 0, 0, 0 {R/O}
  Maximum burst size                    : 0, 0, 0 {R/O}
  Enable modify data pointers (EMDP)    : 0, 0, 0 {R/O}
  Fair arbitration                      : 7, 7, 7
  Disconnect immediate (DImm)           : 0, 0, 0 {R/O}
  Data transfer disconnect control (DTDC) : 0, 0, 0 {R/O}
  First burst size                      : 0, 0, 0 {R/O}

 Format Device                          : Page [03h] (Factory, Current, Saved)
  Tracks per zone                       : 54, 54, 54 {R/O}
  Alternate sectors per zone            : 200, 200, 200
  Alternate tracks per zone             : 0, 0, 0 {R/O}
  Alternate tracks per lun              : 36, 36, 36 {R/O}
  Sectors per track                     : 863, 863, 863 {R/O}
  Bytes per sector                      : 512, 512, 512
  Interleave                            : 1, 1, 1 {R/O}
  Track skew factor                     : 216, 216, 216 {R/O}
```

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```
 Cylinder skew factor                  : 111, 111, 111 {R/O}
 Supports soft sectoring (SSEC)        : 0, 0, 0 {R/O}
 Supports hard sectoring (SHEC)        : 1, 1, 1 {R/O}
 Removable Medium (RMB)                : 0, 0, 0 {R/O}
 Addresses assigned by surface (SURF)  : 0, 0, 0 {R/O}

Rigid Disk Device Geometry             : Page [04h] (Factory, Current, Saved)
 Number of cylinders                   : 49158, 49158, 49158 {R/O}
 Number of heads                       : 2, 2, 2 {R/O}
 Starting write precomp                : 0, 0, 0 {R/O}
 Starting reduced current              : 0, 0, 0 {R/O}
 Drive step rate                       : 0, 0, 0 {R/O}
 Landing Zone Cylinder                 : 0, 0, 0 {R/O}
 RPL                                   : 0, 0, 0 {R/O}
 Rotational Offset                     : 0, 0, 0 {R/O}
 Medium rotation Rate                  : 15000, 15000, 15000 {R/O}

Verify Error Recovery                  : Page [07h] (Factory, Current, Saved)
 EER                                   : 0, 0, 0
 PER                                   : 0, 0, 0
 DTE                                   : 0, 0, 0
 DCR                                   : 0, 0, 0
 Verify Retry Count                    : 63, 63, 63
 Verify Correction Span (bits)         : 255, 255, 255 {R/O}
 Verify Recovery Time Limit (ms)       : 30000, 30000, 30000 {R/O}

Cache Control                          : Page [08h] (Factory, Current, Saved)
 Initiator control (IC)                : 0, 0, 0
 Abort Pre-fetch (ABPF)                : 0, 0, 0 {R/O}
 Caching analysis permitted (CAP)      : 0, 0, 0 {R/O}
 Discontinuity (DISC)                  : 1, 1, 1 {R/O}
 Size enable (Size)                    : 0, 0, 0 {R/O}
 Write cache enable (WCE)              : 1, 0, 0
 Multiplication factor (MF)            : 0, 0, 0 {R/O}
 Read cache disable (RCD)              : 0, 0, 0
 Demand read retention priority        : 0, 0, 0 {R/O}
 Demand Write Retention Priority       : 0, 0, 0 {R/O}
 Disable Pre-fetch Transfer Length     : 65535, 65535, 65535 {R/O}
 Minimum Pre-fetch                     : 0, 0, 0 {R/O}
 Maximum Pre-fetch                     : 0, 0, 0 {R/O}
 Maximum Pre-fetch Ceiling             : 65535, 65535, 65535 {R/O}
 Force sequential write (FSW)          : 1, 1, 1 {R/O}
 LB cache segment size (LBCSS)         : 0, 0, 0 {R/O}
 Disable read-ahead (DRA)              : 0, 0, 0 {R/O}
 Vendor-specific bits (VSS)            : 0, 0, 0 {R/O}
 Number of cache segments              : 8, 8, 8 {R/O}
 Cache segment size                    : 0, 0, 0 {R/O}
 Non cache segment size                : 0, 0, 0 {R/O}

Peripheral Device Parameters           : Page [09h] (Factory, Current, Saved)
 Interface identifier                  : 0, 0, 0 {R/O}
 Reselection retry count               : 4, 4, 4 {R/O}
 Force FAST-20                         : 0, 0, 0
 Force FAST-10                         : 0, 0, 0 {R/O}
 Force 8-BIT                           : 0, 0, 0 {R/O}

Control Mode                           : Page [0Ah] (Factory, Current, Saved)
 TST                                   : 0, 0, 0 {R/O}
 TMF_ONLY                              : 0, 0, 0 {R/O}
 D_SENSE                               : 0, 0, 0
 GLTSD                                 : 0, 0, 0
 RLEC                                  : 0, 0, 0
 Queue algorithm modifier              : 1, 1, 1
 QErr                                  : 0, 0, 0
 DQue                                  : 0, 0, 0
 VS                                    : 0, 0, 0 {R/O}
 RAQ                                   : 0, 0, 0 {R/O}
 UA_INTLCK_CTRL                        : 0, 0, 0 {R/O}
 SWP                                   : 0, 0, 0 {R/O}
 RAERP                                 : 0, 0, 0 {R/O}
 UUAERP                                : 0, 0, 0 {R/O}
```

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```
 EAERP                                  : 0, 0, 0 {R/O}
 ATO                                    : 0, 0, 0 {R/O}
 TAS                                    : 0, 0, 0 {R/O}
 Autoload mode                          : 0, 0, 0 {R/O}
 Ready AER holdoff period               : 0, 0, 0 {R/O}
 Busy timeout period                    : 0, 0, 0 {R/O}
 Extended self-test completion time     : 984, 984, 984 {R/O}

Notch and Partition                     : Page [0Ch] (Factory, Current, Saved)
 Notched Drive (ND)                     : 1, 1, 1 {R/O}
 Logical or Physical Notch (LPN)        : 0, 0, 0
 Max # of notches                       : 18, 18, 18 {R/O}
 Active Notch                           : 0, 0, 0
 Starting Boundary                      : 00000000h, 00000000h, 00000000h
 Ending Boundary                        : 00C00501h, 00C00501h, 00C00501h
 Pages notched                          : 0000000000000008h, 0000000000000008h, 0000000000000008h

Protocol Specific Port                  : Page [19h] (Factory, Current, Saved)
 Physical interface                     : Parallel SCSI
 Driver strength                        : 1, 1, 1 {R/O}
 Driver asymmetry                       : 0, 0, 0 {R/O}
 Driver precompensation                 : 0, 0, 0 {R/O}
 Driver slew rate                       : 0, 0, 0 {R/O}
 DB(0) Value                            : 0, 0, 0 {R/O}
 DB(1) Value                            : 0, 0, 0 {R/O}
 DB(2) Value                            : 0, 0, 0 {R/O}
 DB(3) Value                            : 0, 0, 0 {R/O}
 DB(4) Value                            : 0, 0, 0 {R/O}
 DB(5) Value                            : 0, 0, 0 {R/O}
 DB(6) Value                            : 0, 0, 0 {R/O}
 DB(7) Value                            : 0, 0, 0 {R/O}
 DB(8) Value                            : 0, 0, 0 {R/O}
 DB(9) Value                            : 0, 0, 0 {R/O}
 DB(10) Value                           : 0, 0, 0 {R/O}
 DB(11) Value                           : 0, 0, 0 {R/O}
 DB(12) Value                           : 0, 0, 0 {R/O}
 DB(13) Value                           : 0, 0, 0 {R/O}
 DB(14) Value                           : 0, 0, 0 {R/O}
 P_CRCA                                 : 0, 0, 0 {R/O}
 P1                                     : 0, 0, 0 {R/O}
 BSY                                    : 0, 0, 0 {R/O}
 SEL                                    : 0, 0, 0 {R/O}
 RST                                    : 0, 0, 0 {R/O}
 REQ                                    : 0, 0, 0 {R/O}
 ACK                                    : 0, 0, 0 {R/O}
 ATN                                    : 0, 0, 0 {R/O}
 C/D                                    : 0, 0, 0 {R/O}
 I/O                                    : 0, 0, 0 {R/O}
 MSG                                    : 0, 0, 0 {R/O}
 Transfer period factor                 : 0, 0, 0 {R/O}
 REQ/ACK offset timing                  : 0, 0, 0 {R/O}
 Transfer width exponent                : 1, 1, 1 {R/O}
 Protocol options bits                  : 09h, 09h, 09h
 Driver asymmetry                       : 0, 0, 0 {R/O}
 Sent PCOMP enabled                     : 0, 0, 0 {R/O}
 Received PCOMP enabled                 : 0, 0, 0 {R/O}
 Min xfr period factor                  : 0, 0, 0 {R/O}
 Max REQ/ACK offset                     : 0, 0, 0 {R/O}
 Max transfer width exponent            : 1, 1, 1 {R/O}
 Protocol options bits supported        : 08h, 08h, 08h

Power Condition                         : Page [1Ah] (Factory, Current, Saved)
 Idle                                   : 0, 0, 0
 Standby                                : 0, 0, 0
 Idle condition timer                   : FFFFFFFFh, FFFFFFFFh, FFFFFFFFh
 Standby condition timer                : FFFFFFFFh, FFFFFFFFh, FFFFFFFFh

Informational Exceptions Control        : Page [1Ch] (Factory, Current, Saved)
 PERF                                   : 0, 0, 0
 EBF                                    : 0, 0, 0
 EWASC                                  : 1, 1, 1
```

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```
  DExcpt                                  : 0, 0, 0
  TEST                                    : 0, 0, 0
  EBACKERR                                : 0, 0, 0 {R/O}
  LogErr                                  : 1, 1, 1
  MRIE                                    : 2, 2, 2 {R/O}
  Interval timer                          : 00000BB8h, 00000BB8h, 00000BB8h
  Report count                            : 00000002h, 00000002h, 00000002h


Program Ended.
```

1.26.4 Example Mode Page Dump - SCSI Tape

The results below were run under Windows XP using a Tandberg SLR7 Tape

```
C>\scratch>smartmon-ux -J \\.\TAPE0
SMARTMon-UX [Release 1.41, Build  1-NOV-2009] - Copyright 2001-2009 SANtools(R), Inc. http://www.SANtools.
com
Discovered TANDBERG SLR7 S/N "SN007005396" on \\.\TAPE0 (tape) [Bus/Port/ID.LUN=0/3/12.0]
 Read-Write Error Recovery                : Page [01h] (Factory, Current, Saved)
  Transfer block (TB)                     : 0, 0, 0 {R/O}
  Enable early recovery (EER)             : 1, 1, 1 {R/O}
  Post error (PER)                        : 0, 0, 0 {R/O}
  Disable transfer on error (DTE)         : 0, 0, 0 {R/O}
  Disable correction (DCR)                : 0, 0, 0
  Read retry count (RRC)                  : 24, 24, 24
  Write Retry Count (WRC)                 : 16, 16, 16

 Disconnect-Reconnect                     : Page [02h] (Factory, Current, Saved)
  Buffer full ratio (BFR)                 : 16, 16, 16
  Buffer empty ratio (BER)                : 16, 16, 16
  Bus inactivity limit (BIL)              : 0, 0, 0 {R/O}
  Disconnect time limit (DTL)             : 0, 0, 0 {R/O}
  Connect time limit (CTL)                : 0, 0, 0 {R/O}
  Maximum burst size (MBS)                : 0, 0, 0
  Enable modify data pointers (EMDP)      : 0, 0, 0 {R/O}
  Fair arbitration (FA)                   : 0, 0, 0 {R/O}
  Disconnect immediate (DImm)             : 0, 0, 0 {R/O}
  Data transfer disconnect control (DTDC) : 0, 0, 0 {R/O}
  First burst size (FBS)                  : 0, 0, 0 {R/O}

 Control Mode                             : Page [0Ah] (Factory, Current, Saved)
  Task set type (TST)                     : 0, 0, 0 {R/O}
  Task mgmt only (TMF_ONLY)               : 0, 0, 0 {R/O}
  Descriptor format (D_SENSE)             : 0, 0, 0 {R/O}
  Global logging disable (GLTSD)          : 0, 0, 0 {R/O}
  Report log excp. (RLEC)                 : 0, 0, 0
  Queue alg. modifier (QAM)               : 0, 0, 0 {R/O}
  Queue error mgmt (QERR)                 : 0, 0, 0 {R/O}
  (DQUE)                                  : 0, 0, 0 {R/O}
  (VS)                                    : 0, 0, 0 {R/O}
  Report check (RAQ)                      : 0, 0, 0 {R/O}
  Unit attn interlocks (UA_INTLCK)        : 0, 0, 0 {R/O}
  Software write prot (SWP)               : 0, 0, 0 {R/O}
  (RAERP)                                 : 0, 0, 0 {R/O}
  (UUAERP)                                : 0, 0, 0 {R/O}
  (EAERP)                                 : 0, 0, 0 {R/O}
  App tag owner (ATO)                     : 0, 0, 0 {R/O}
  Task aborted status (TAS)               : 0, 0, 0 {R/O}
  Autoload mode (AUTOL)                   : 0, 0, 0 {R/O}
  Ready AER holdoff period (RAER)         : 0, 0, 0 {R/O}
  Busy timeout period (BTP)               : 65535, 65535, 65535 {R/O}
  Extended self-test time (ESTCT)         : 0, 0, 0 {R/O}

 Data Compression                         : Page [0Fh] (Factory, Current, Saved)
  DCE                                     : 1, 0, 1
  DCC                                     : 1, 1, 1 {R/O}
  DDE                                     : 1, 1, 1
  RED                                     : 0, 0, 0
```

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```
  Compression algorithm                  : 00000003h, 00000003h, 00000003h
  Decompression algorithm                : 00000000h, 00000003h, 00000000h

 Tape Control                            : Page [10h] (Factory, Current, Saved)
  Change active partition (CAP)          : 0, 0, 0
  Change active format (CAF)             : 0, 0, 0 {R/O}
  Active format                          : 0, 0, 0 {R/O}
  Active partition                       : 0, 0, 0
  Write buffer full ratio                : 0, 0, 0 {R/O}
  Read buffer empty ratio                : 0, 0, 0 {R/O}
  Write delay time (in 100ms)            : 0, 0, 0
  Data buffer recovery (DBR)             : 0, 0, 0 {R/O}
  Block identifiers supported (BIS)      : 1, 1, 1 {R/O}
  Report setmarks (RSMK)                 : 1, 1, 1 {R/O}
  Automatic velocity control (AVC)       : 0, 1, 1
  Stop on consecutive filemarks (SOCF)   : 0, 0, 0 {R/O}
  Recover buffer over (RBO)              : 0, 0, 0 {R/O}
  Recover error warning (REW)            : 0, 0, 0 {R/O}
  Gap size                               : 0, 0, 0 {R/O}
  EOD Defined                            : 0, 0, 0 {R/O}
  Enable EOD generation (EEG)            : 1, 1, 1 {R/O}
  Synchronize early warning (SEW)        : 1, 1, 1 {R/O}
  Soft write protect (SWP)               : 0, 0, 0 {R/O}
  Buffer size at early warning           : 000000h, 000000h, 000000h
  Data compression algorithm             : 00h, 00h, 00h
  Associated write protect (ASOCWP)      : 0, 0, 0 {R/O}
  Persistent write protect (PERSWP)      : 0, 0, 0 {R/O}
  Permanent write protect (PRMWP)        : 0, 0, 0 {R/O}

 Medium Partition                        : Page [11h] (Factory, Current, Saved)
  Maximum additional partitions          : 35, 2, 35
  Additional partitions defined          : 0, 0, 0
  Fixed data partitions (FDP)            : 0, 0, 0
  Select data partitions (SDP)           : 0, 0, 0 {R/O}
  Initiator-defined partitions (IDP)     : 0, 0, 0
  Partition size unit-of-measure (PSUM)  : 2, 2, 2
  Partition on format (POFM)             : 0, 0, 0 {R/O}
  CLEAR                                  : 0, 0, 0 {R/O}
  ADDP                                   : 0, 0, 0 {R/O}
  Medium format recognition              : 01h, 01h, 01h
  Partition Units                        : 0, 0, 0

 Informational Exceptions Control        : Page [1Ch] (Factory, Current, Saved)
  PERF                                   : 0, 0, 0 {R/O}
  EBF                                    : 0, 0, 0 {R/O}
  EWASC                                  : 0, 0, 0 {R/O}
  DExcpt                                 : 1, 1, 1 {R/O}
  TEST                                   : 0, 0, 0
  EBACKERR                               : 0, 0, 0 {R/O}
  LogErr                                 : 0, 0, 0 {R/O}
  MRIE                                   : 0, 0, 0 {R/O}
  Interval timer                         : 00000000h, 00000000h, 00000000h
  Report count                           : 00000000h, 00000000h, 00000000h


Program Ended.
```

1.27 Batch Mode Page Import/Export

This feature will save all of the mode pages for a selected device into a file which you can export to one or more devices with a single command.

Reading Mode Pages and Saving to File

Syntax: `smartmon-ux -mpexport FILENAME device`

Example: `smartmon-ux -mpexport SEAGATEMASTER.TXT /dev/rdsk/c0d0s0`

The above will read all mode pages from the selected disk and save it to a file. Note that this is one of the few commands that will not allow you to enter a *list* of devices. If you attempt to enter a wild-card for the device that would

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match more than one, the program will still create the exported file, but the program will abort once the wildcard matches the second device.

Below is the output from a Seagate ST39175LC disk drive.

```
#
# *** WARNING *** Do NOT change any lines starting with a ";"
; File generated with SANtools' SMARTMon-UX revision 1.28
; http://www.santools.com  sales@santools.com
#
; Mode page dump generated at Tue Mar 22 23:43:56 2005
; Device is "" ""
#
# Note: You are free to add, delete, edit mode pages and values as required
#       only the mode pages in this file will be saved back into the device when
#       you issue the -mpimport command.  All other pages will not be affected.
#
#       Obviously very bad things can happen to a device if you make a mistake and
#       load incorrect values, or load correct values onto the wrong peripheral.
#
#       CURRENT Pages -> These are volatile and reset to SAVED pages with power cycle (changeable)
#       FACTORY Pages -> These are factory settings burned into the firmware (not changeable)
#       SAVED Pages   -> Power-on default pages (changeable)
#       CHANGEABLE    -> The non-changeable pages are bitmasks where a 1 indicates a bit is changeable
#
#       So ... The safest thing to do is just make changes to the CURRENT page to see
#       if it behaves as you desired. If so, then burn the SAVED pages.
#       Do this by just commenting out the text with leading #
#
#       Record layout information:
#       Each record contains the 12 byte header which corresponds to the standard 4-byte header which
#       is then followed by the 8 byte block descriptor. Do NOT change any of these values.
#       Next, you have the mode page itself.  The 13th byte corresponds to the first byte of the mode
#       page. You will note the high order bit is set for the mode page number. This is due to the
#       ANSI specification, and is something that is done for this byte only. So, if you want mode
#       page number 3, you will see this reported as 83h.
#
#
#   The 14th byte corresponds to second mode page byte, which is always the page length.
#
#   Example:  You want to enable the write cache for a disk.  The ANSI spec states this is bit #2, byte #2
#             on mode page 8. (So the 88 corresponds to Mode page byte #0)
#             Sample Original Value (Write cache disabled):
#                ; ModePage 08 SAVED:
#                000000 1F 00 10 08 04 45 DC CC 00 00 02 00 88 12 10 00
#                000010 FF FF 00 00 FF FF FF FF 00 20 00 00 00 00 00 00
#
#             Change to:
#                ; ModePage 08 SAVED:
#                000000 1F 00 10 08 04 45 DC CC 00 00 02 00 88 12 14 00
#                000010 FF FF 00 00 FF FF FF FF 00 20 00 00 00 00 00 00
#
; ModePage 00 CURRENT
000000 0F 00 10 08 01 0F 33 D4 00 00 02 00 80 02 07 00
; ModePage 00 CHANGEABLE [read only]:
000000 0F 00 10 08 01 0F 33 D4 00 00 02 00 80 02 77 40
; ModePage 00 FACTORY [read only]:
000000 0F 00 10 08 01 0F 33 D4 00 00 02 00 80 02 00 00
; ModePage 00 SAVED:
000000 0F 00 10 08 01 0F 33 D4 00 00 02 00 80 02 07 00
; ModePage 00 END
; ModePage 01 CURRENT
000000 17 00 10 08 01 0F 33 D4 00 00 02 00 81 0A C4 0B
000010 E8 00 00 00 0F 00 FF FF
; ModePage 01 CHANGEABLE [read only]:
000000 17 00 10 08 01 0F 33 D4 00 00 02 00 81 0A FF FF
000010 00 00 00 00 FF 00 FF FF
; ModePage 01 FACTORY [read only]:
000000 17 00 10 08 01 0F 33 D4 00 00 02 00 81 0A C0 0B
000010 E8 00 00 00 0F 00 FF FF
; ModePage 01 SAVED:
```

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```
000000 17 00 10 08 01 0F 33 D4 00 00 02 00 81 0A C4 0B
000010 E8 00 00 00 0F 00 FF FF
; ModePage 01 END
; ModePage 02 CURRENT
000000 1B 00 10 08 01 0F 33 D4 00 00 02 00 82 0E 80 80
000010 00 0A 00 00 00 00 00 00 00 00 00 00
; ModePage 02 CHANGEABLE [read only]:
000000 1B 00 10 08 01 0F 33 D4 00 00 02 00 82 0E FF FF
000010 00 00 00 00 00 00 00 00 87 00 00 00
; ModePage 02 FACTORY [read only]:
000000 1B 00 10 08 01 0F 33 D4 00 00 02 00 82 0E 80 80
000010 00 0A 00 00 00 00 00 00 00 00 00 00
; ModePage 02 SAVED:
000000 1B 00 10 08 01 0F 33 D4 00 00 02 00 82 0E 80 80
000010 00 0A 00 00 00 00 00 00 00 00 00 00
; ModePage 02 END
; ModePage 03 CURRENT
000000 23 00 10 08 01 0F 33 D4 00 00 02 00 83 16 0A BE
000010 00 00 00 10 00 00 01 30 02 00 00 01 00 30 00 34
000020 40 00 00 00
; ModePage 03 CHANGEABLE [read only]:
000000 23 00 10 08 01 0F 33 D4 00 00 02 00 83 16 00 00
000010 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
000020 00 00 00 00
; ModePage 03 FACTORY [read only]:
000000 23 00 10 08 01 0F 33 D4 00 00 02 00 83 16 0A BE
000010 00 00 00 10 00 00 01 30 02 00 00 01 00 30 00 34
000020 40 00 00 00
; ModePage 03 SAVED:
000000 23 00 10 08 01 0F 33 D4 00 00 02 00 83 16 0A BE
000010 00 00 00 10 00 00 01 30 02 00 00 01 00 30 00 34
000020 40 00 00 00
; ModePage 03 END
; ModePage 04 CURRENT
000000 23 00 10 08 01 0F 33 D4 00 00 02 00 84 16 00 2D
000010 C9 05 00 00 00 00 00 00 00 00 00 00 00 00 00 00
000020 1C 27 00 00
; ModePage 04 CHANGEABLE [read only]:
000000 23 00 10 08 01 0F 33 D4 00 00 02 00 84 16 00 00
000010 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
000020 00 00 00 00
; ModePage 04 FACTORY [read only]:
000000 23 00 10 08 01 0F 33 D4 00 00 02 00 84 16 00 2D
000010 C9 05 00 00 00 00 00 00 00 00 00 00 00 00 00 00
000020 1C 27 00 00
; ModePage 04 SAVED:
000000 23 00 10 08 01 0F 33 D4 00 00 02 00 84 16 00 2D
000010 C9 05 00 00 00 00 00 00 00 00 00 00 00 00 00 00
000020 1C 27 00 00
; ModePage 04 END
; ModePage 07 CURRENT



000000 17 00 10 08 01 0F 33 D4 00 00 02 00 87 0A 00 0B
000010 E8 00 00 00 00 00 FF FF
; ModePage 07 CHANGEABLE [read only]:
000000 17 00 10 08 01 0F 33 D4 00 00 02 00 87 0A 0F FF
000010 00 00 00 00 00 00 FF FF
; ModePage 07 FACTORY [read only]:
000000 17 00 10 08 01 0F 33 D4 00 00 02 00 87 0A 00 0B
000010 E8 00 00 00 00 00 FF FF
; ModePage 07 SAVED:
000000 17 00 10 08 01 0F 33 D4 00 00 02 00 87 0A 00 0B
000010 E8 00 00 00 00 00 FF FF
; ModePage 07 END
; ModePage 08 CURRENT
000000 17 00 10 08 01 0F 33 D4 00 00 02 00 88 0A 10 00
000010 FF FF 00 00 FF FF FF FF
; ModePage 08 CHANGEABLE [read only]:
```

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```
#
; ModePage 1A SAVED:
000000 17 00 10 08 01 0F 33 D4 00 00 02 00 9A 0A 00 03
000010 00 00 00 01 00 00 00 04
; ModePage 1A END
; ModePage 1C CURRENT
000000 17 00 10 08 01 0F 33 D4 00 00 02 00 9C 0A 00 04
000010 00 00 17 70 00 00 00 00
; ModePage 1C CHANGEABLE [read only]:
000000 17 00 10 08 01 0F 33 D4 00 00 02 00 9C 0A 8D 0F
000010 FF FF FF FF FF FF FF FF
; ModePage 1C FACTORY [read only]:
000000 17 00 10 08 01 0F 33 D4 00 00 02 00 9C 0A 00 00
000010 00 00 00 00 00 00 00 01
; ModePage 1C SAVED:
000000 17 00 10 08 01 0F 33 D4 00 00 02 00 9C 0A 08 00
000010 00 00 00 00 00 00 00 01
; ModePage 1C END
#
# End-of-file
```

Writing (Exporting) Mode Pages and Saving to File

Syntax: **smartmon-ux-mpimport-ux FILENDevice_list 22AME**

Example: **smartmon-ux -mpimport SEAGATEMASTER.TXT /dev/rdsk/c0d0s0**

The above will read and save all information from the file and save it to the device. You can also clone mode pages to more than one device at a time by entering multiple devices or using wild cards.
(Such as **smartmon-ux -mpexport SEAGATEMASTER.TXT /dev/rdsk/c0d1s0 /dev/rdsk/c0d2s0**)

Application Notes & Comments

The file used with these commands is in ASCII format so you can modify it with a standard text editor.

To leave individual byte settings unchanged, replace those bytes with the **XX** characters, as in:

```
000000 17 00 10 08 01 0F 33 D4 00 00 02 00 9C XX 00 XX
```

If you wanted to leave a particular mode page unchanged, delete it from the file. If you wanted to leave the SAVED settings alone for the drive above, delete the three lines marked **in blue** from the file, then run the **-mpexport** command as before.

The FACTORY and CHANGEABLE pages are not programmable. We chose to copy them into the file because it is convenient for the user to know this information. The program does not view or interpret this information in any way.

Other features of mpexport:

- All lines beginning with the # character are ignored. Feel free to append the file with additional comments.
- Currently, the program ignores the "**;**" lines that report the timestamp and the make/model of device. This may change in the future, so do not modify them.
- Do not modify any lines that begin with the "**;**"
- 10-byte mode pages are not supported in the initial release. If your device uses the 10-byte version of MODE SENSE or MODE SELECT, those pages will be skipped.

Warning:

Changing mode pages can be dangerous if you do not know what you are doing. We advise you to always take the conservative approach and just change the CURRENT page to make sure the settings have the desired affect (use the # character to comment out the SAVED pages in the file).

If things do not go well, you can just recycle power and the device. The CURRENT page will revert to the SAVED page.

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1.28 Partition Identification

The **-Q** option is available on Windows, LINUX, OS X, IRIX, and Solaris platforms. This flag will instruct the software to dump and identify the primary partition table. This function is not infallible as there are several Windows-family volume managers that extend the partition information and allow you to add nearly unlimited permutations. Our software does not attempt to decode everything. It can, however, decode an extensive list of partition types which includes some obsolete operating systems.

All operating systems
Reports 4 primary partitions and returns one of the following strings:

- Primary DOS 12-bit FAT
- xenix / file system
- xenix /usr file system
- Primary DOS 16-bit FAT
- Extended DOS
- Primary big DOS >32Mb
- OS/2 HPFS, NTFS, QNX or Advanced Unix
- AIX boot partition
- AIX file system partition or Coherent
- OS/2 Boot Manager or Coherent
- DOS or Windows 95 with 32-bit FAT
- DOS or Windows 95 with 32-bit FAT, LBA
- Primary big DOS >32Mb LBA
- Extended DOS, LBA
- OPUS
- DOS 12-bit FAT Hidden Partition
- Compaq Configuration Partition
- DOS 16-bit FAT <32Mb Hidden
- DOS 16-bit FAT >=32Mb Hidden
- OS/2 HPFS Hidden
- AST Windows swapfile
- Willowtech Photon coS
- WIN95 OSR2 32-bit FAT Hidden
- WIN95 OSR2 32-bit FAT, LBA, Hidden
- FAT95 Hidden
- Willowsoft Overture Filesystem
- FSo2 Oxygen Filesystem
- Extended Oxygen Filesystem
- NEC DOS 3.x
- THEOS ver 3.2 2Gb Partition
- THEOS ver 4 Spanned Partition
- THEOS ver 4 4Gb Partition
- THEOS ver 4 Extended Partition
- PartitionMagic Recovery Partition
- VENIX 286
- PPC PReP Boot
- SFS (Secure File System)
- QNX 4.x
- QNX 4.x 2nd part
- QNX 4.x 3rd part
- OnTrack DM
- OnTrack DM6 Aux (51)
- CP/M or Microport SysV/AT
- OnTrack DM6 Aux (53)

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- OnTrack DM6
- EZ-Drive"); break;
- GoldenBow VFeature
- Priam EDisk
- Speedstor
- ISC Unix, System V/386, GNU HURD or Mach
- Novell Netware 2.xx
- Novell Netware 3.xx
- DiskSecure Multi-Boot
- IBM PCIX
- Minix 1.1 -> 1.4a
- Minix 1.4b -> 1.5.10
- Linux Swap
- Linux Filesystem
- OS/2 type 04 hidden DOS C:
- Linux extended
- NTFS volume set (type 86)
- NTFS volume set (type 87)
- Linux LVM
- Amoeba Filesystem
- Amoeba Bad Block Table
- BSD/OS
- IBM Thinkpad
- FreeBSD/NetBSD/386BSD
- OpenBSD
- NeXTSTEP
- ESDI BSD/386 Filesystem
- BSDI BSD/386 swap
- Boot Wizard
- DR-DOS 6.0 secured 12-bit FAT partition
- DR-DOS 6.0 secured 16-bit FAT partition
- DR-DOS 6.0 secured Huge partition
- Syrinx
- Non FS data
- Concurrent CPM, C.DOS, CTOS
- Dell Utility
- BootIt
- DOS Access
- DOS R/O
- BeOS
- EFI GPT
- EFI FAT
- DOS 3.3+ Secondary
- SpeedStor
- Linux RAID Auto
- LANstep
- Xenix Bad Block Table
- Unknown-Type=XXh (This is the catch-all for other types we can't decode)

In addition to the partition type, the software will append [BOOTABLE] if this is the bootable primary partition. All partitions will also report the total block count and MB in the partition.

Apple OS X Specific
Identifies if partition(s) are Allocated, In-Use, Bootable, Readable, Writable

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Sample Output (Windows)

```
D:\msdevstd\projects\smartmonux125\Debug>smartmon-ux -Q
SMARTMon-ux [Release 1.28A, Build 28-MAY-2005] - Copyright 2001-2005 SANtools, Inc. http://www.SANtools.com
Discovered HITACHI_DK23EA-60 S/N "JP7348" on \\.\PhysicalDrive0 (SMART Enabled)
 Partition table dump below:
  0000: 33 C0 8E D0 BC 00 7C FB 50 07 50 1F FC BE 1B 7C    3.....|.P.P....|
  0010: BF 1B 06 50 57 B9 E5 01 F3 A4 CB BD BE 07 B1 04    ...PW...........
  0020: 38 6E 00 7C 09 75 13 83 C5 10 E2 F4 CD 18 8B F5    8n.|.u..........
  0030: 83 C6 10 49 74 19 38 2C 74 F6 A0 B5 07 B4 07 8B    ...It.8,t.......
  0040: F0 AC 3C 00 74 FC BB 07 00 B4 0E CD 10 EB F2 88    ..<.t...........
  0050: 4E 10 E8 46 00 73 2A FE 46 10 80 7E 04 0B 74 0B    N..F.s*.F..~..t.
  0060: 80 7E 04 0C 74 05 A0 B6 07 75 D2 80 46 02 06 83    .~..t....u..F...
  0070: 46 08 06 83 56 0A 00 E8 21 00 73 05 A0 B6 07 EB    F...V...!.s.....
  0080: BC 81 3E FE 7D 55 AA 74 0B 80 7E 10 00 74 C8 A0    ..>.}U.t..~..t..
  0090: B7 07 EB A9 8B FC 1E 57 8B F5 CB BF 05 00 8A 56    .......W.......V
  00a0: 00 B4 08 CD 13 72 23 8A C1 24 3F 98 8A DE 8A FC    .....r#..$?.....
  00b0: 43 F7 E3 8B D1 86 D6 B1 06 D2 EE 42 F7 E2 39 56    C..........B..9V
  00c0: 0A 77 23 72 05 39 46 08 73 1C B8 01 02 BB 00 7C    .w#r.9F.s......|
  00d0: 8B 4E 02 8B 56 00 CD 13 73 51 4F 74 4E 32 E4 8A    .N..V...sQOtN2..
  00e0: 56 00 CD 13 EB E4 8A 56 00 60 BB AA 55 B4 41 CD    V......V.`..U.A.
  00f0: 13 72 36 81 FB 55 AA 75 30 F6 C1 01 74 2B 61 60    .r6..U.u0...t+a`
  0100: 6A 00 6A 00 FF 76 0A FF 76 08 6A 00 68 00 7C 6A    j.j..v..v.j.h.|j
  0110: 01 6A 10 B4 42 8B F4 CD 13 61 61 73 0E 4F 74 0B    .j..B....aas.Ot.
  0120: 32 E4 8A 56 00 CD 13 EB D6 61 F9 C3 49 6E 76 61    2..V.....a..Inva
  0130: 6C 69 64 20 70 61 72 74 69 74 69 6F 6E 20 74 61    lid partition ta
  0140: 62 6C 65 00 45 72 72 6F 72 20 6C 6F 61 64 69 6E    ble.Error loadin
  0150: 67 20 6F 70 65 72 61 74 69 6E 67 20 73 79 73 74    g operating syst
  0160: 65 6D 00 4D 69 73 73 69 6E 67 20 6F 70 65 72 61    em.Missing opera
  0170: 74 69 6E 67 20 73 79 73 74 65 6D 00 00 00 00 00    ting system.....
  0180: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  0190: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  01a0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  01b0: 00 00 00 00 00 2C 44 63 3C E5 3C E5 00 00 80 01    .....,Dc<.<.....
  01c0: 01 00 07 FE FF FF 3F 00 00 00 EC ED E1 04 00 FE    ......?.........
  01d0: FF FF 0C FE FF FF 2B EE E1 04 7E 04 7D 00 00 00    ......+...~.}...
  01e0: C1 FF 0F FE FF FF BE 4E EC 06 C2 2D 10 00 00 00    .......N...-....
  01f0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 55 AA    ..............U.
  Partition #0: Type=OS/2 HPFS, NTFS, QNX or Advanced Unix [BOOTABLE], Starting block=63, Total
blocks=81915372, MB=39997
  Partition #1: Type=DOS or Windows 95 with 32-bit FAT, LBA, Starting block=81915435, Total blocks=8193150,
MB=4000
  Partition #2: Type=Extended DOS, LBA, Starting block=116149950, Total blocks=1060290, MB=517
  Partition #3: Type=Unknown

Discovered HL-DT-ST DVD-ROM GDR8081N S/N " " on \\.\CDROM0 (CD/DVD) [Bus/Port/ID.LUN=0/1/0.0]


Program Ended.
```

Sample Output (IRIX)

```
# /etc/smartmon-ux -Q /hw/sc0d1l0
SMARTMonUX [Release 1.31C, Build 18-JAN-2007] - Copyright 2001-2006 SANtools, Inc. http://www.SANtools.com
Discovered SEAGATE ST39175LC S/N "3AL07K7P" on /hw/scsi/sc0d1l0 (SMART enabled)(8678 MB)

 Partition table dump below:
  0000: 0B E5 A9 41 00 00 00 01 2F 75 6E 69 78 00 00 00    ...A..../unix...
  0010: 00 00 00 00 00 00 00 00 00 00 00 00 2D AD 00 00    ............-...
  0020: 00 05 02 00 00 00 01 30 02 00 00 00 00 00 00 40    .......0.......@
  0030: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  0040: 00 00 00 00 00 01 0F 33 D4 73 67 69 6C 61 62 65 6C  ......3.sgilabel
  0050: 00 00 00 02 00 00 02 00 69 64 65 00 00 00 00 00    ........ide.....
  0060: 00 00 02 6D 00 04 EE 00 73 61 73 68 00 00 00 00    ...m....sash....
  0070: 00 00 04 E4 00 04 EE 00 00 00 00 00 00 00 00 00    ................
  0080: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  0090: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  00a0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  00b0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  00c0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  00d0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
```

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```
00e0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
00f0: 00 00 00 00 00 00 00 00 61 73 68 00 00 00 00       ........ash....
0100: FF FF FF FF 00 00 00 00 00 00 00 00 00 00 00 00    ................
0110: 00 00 00 00 00 00 00 00 61 73 68 00 00 00 00       ........ash....
0120: FF FF FF FF 00 00 00 00 00 64 65 00 00 00 00 00    .........de.....
0130: FF FF FF FF 00 00 00 00 01 0B 23 D4 00 04 10 00    ..........#.....
0140: 00 00 00 0A 00 04 00 00 00 00 10 00 00 00 00 03    ................
0150: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
0160: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
0170: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
0180: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
0190: 00 00 00 00 00 00 00 00 00 00 10 00 00 00 00 00    ................
01a0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
01b0: 01 0F 33 D4 00 00 00 00 00 00 00 06 00 00 00 00    ..3.............
01c0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
01d0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
01e0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
01f0: 00 00 00 00 00 00 00 00 67 00 50 F6 00 00 00 00    ........g.P.....

Decoded Partition Header Information----------------------------------------------------
Num  Name        Start    nBlocks Type            Description
  0  root       266240   17507284 SGI XFS         Root partition, used for root filesystem
  1  swap         4096     262144 Raw data        Virtual memory space
  8  volhdr          0       4096 Volume header   Volume header
 10  volume          0   17773524 Entire volume   The entire disk including volume header

Decoded Volume Header Information -------------------
Num  Label       StartBlock  Size(Bytes)     Size(KB)
  0  sgilabel             2          512            0
  1  ide                621       323072          315
  2  sash              1252       323072          315
  3  -                    0            0            0
  4  -                    0            0            0
  5  -                    0            0            0
  6  -                    0            0            0
  7  -                    0            0            0
  8  -                    0            0            0
  9  -                    0            0            0
 10  -                    0            0            0
 11  -           4294967295            0            0
 12  -                    0            0            0
 13  -           4294967295            0            0
 14  -           4294967295            0            0
```

1.29 Ping Command

You may add the **-ping** command to modify reporting behavior when devices are polled. This option is added to polling operations to report if a device has been removed or no longer reporting. You would generally use this function if you have an environment where you might not necessarily care about the health of a device, but you do want to know if the device has been removed.

This was added as an enhancement for some national security-related organization that needed 24x7 monitoring to make sure that no peripherals were removed. The default operation of the software is to just ignore a device if it is no longer reporting.

This is what will be logged with a 10-second polling and a ping. The disk at /dev/sdf is an external ATA disk drive attached via a USB port. The command that was issued was:

```
./smartmon-ux -ping -L /dev/sdf -F 10 /dev/sdf
```

```
Wed Mar 23 19:45:45 2005: ./smartmon-ux started
Wed Mar 23 19:45:45 2005: Discovered WDC WD25 00JB-75FUA0 S/N " " on /dev/sdf (SMART unsupported)(238418 MB)
Wed Mar 23 19:46:05 2005: /dev/sdf polled at Wed Mar 23 07:46:05 2005 Status:Online [WDC WD25 00JB-75FUA0]
Wed Mar 23 19:46:15 2005: /dev/sdf polled at Wed Mar 23 07:46:15 2005 Status:Offline [S/N= ]
Wed Mar 23 19:46:45 2005: /dev/sdf polled at Wed Mar 23 07:46:45 2005 Status:Online [S/N= ]
Wed Mar 23 19:46:55 2005: /dev/sdf polled at Wed Mar 23 07:46:55 2005 Status:Online [WDC WD25 00JB-75FUA0]
```

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```
Wed Mar 23 19:47:05 2005: /dev/sdf polled at Wed Mar 23 07:47:05 2005 Status:Online [WDC WD25 00JB-75FUA0]
Wed Mar 23 19:47:15 2005: /dev/sdf polled at Wed Mar 23 07:47:15 2005 Status:Online [WDC WD25 00JB-75FUA0]
```

While the device was unplugged, the status was reported as Offline, and when it was plugged in again, it reported online. The reason why the clock reported more than 10 seconds was to allow the operating system and device drivers a longer timeout window to make sure the device was not responding vs. busy.

Note also that the make and model strings in the WD disk drive are not 100% correct, and no serial number is reported. This is because the USB **dongle** card that is built into the external USB enclosure has some minor bugs with their emulation. Below is sample output for what would be reported if you unplugged a Seagate SCSI disk drive. This also shows the difference in output if you do not use the -ping command.

Here is an example where we polled 2 Seagate disk drives with the command. (No -ping was used).

```
./smartmon-ux -L - F 10 /dev/sd[b-c]
Fri Mar 25 23:18:38 2005: Discovered SEAGATE ST336706LC S/N "3FD010LG" on /dev/sdb (SMART enabled)(35003 MB)
Fri Mar 25 23:18:38 2005: Discovered SEAGATE ST373307LC S/N "3HZ0381E" on /dev/sdc (SMART enabled)(70007 MB)
Fri Mar 25 23:18:38 2005: /dev/sdb polled at Fri Mar 25 23:18:38 2005 Status:Passed
Fri Mar 25 23:18:38 2005: /dev/sdc polled at Fri Mar 25 23:18:38 2005 Status:Passed
Fri Mar 25 23:18:48 2005: /dev/sdb polled at Fri Mar 25 23:18:48 2005 Status:Passed
Fri Mar 25 23:18:48 2005: /dev/sdc polled at Fri Mar 25 23:18:48 2005 Status:Passed
Fri Mar 25 23:18:58 2005: /dev/sdb polled at Fri Mar 25 23:18:58 2005 Status:Passed
Fri Mar 25 23:18:58 2005: /dev/sdc polled at Fri Mar 25 23:18:58 2005 Status:Passed
Fri Mar 25 23:19:08 2005: /dev/sdb polled at Fri Mar 25 23:19:08 2005 Status:Passed
```

(We unplugged the disk at /dev/sdc).

```
Fri Mar 25 23:19:09 2005: /dev/sdc polled at Fri Mar 25 23:19:08 2005 - Device offline (skipping)
Fri Mar 25 23:19:19 2005: /dev/sdb polled at Fri Mar 25 23:19:19 2005 Status:Passed
Fri Mar 25 23:19:19 2005: /dev/sdc polled at Fri Mar 25 23:19:19 2005 - Device offline (skipping)
Fri Mar 25 23:19:29 2005: /dev/sdb polled at Fri Mar 25 23:19:29 2005 Status:Passed
Fri Mar 25 23:19:30 2005: /dev/sdc polled at Fri Mar 25 23:19:29 2005 - Device offline (skipping)
Fri Mar 25 23:19:40 2005: /dev/sdb polled at Fri Mar 25 23:19:40 2005 Status:Passed
```

Below is with the -ping. (Note serial number is reported).

```
./smartmon-ux -L - F 10 -ping /dev/sd[b-c]
Fri Mar 25 23:24:51 2005: Discovered SEAGATE ST336706LC S/N "3FD010LG" on /dev/sdb (Enabling SMART)(35003
MB)
Fri Mar 25 23:24:51 2005: Discovered SEAGATE ST373307LC S/N "3HZ0381E" on /dev/sdc (Enabling SMART)(70007
MB)
Fri Mar 25 23:24:51 2005: /dev/sdb polled at Fri Mar 25 23:24:51 2005 Status:Online [S/N=3FD010LG]
Fri Mar 25 23:24:51 2005: /dev/sdc polled at Fri Mar 25 23:24:51 2005 Status:Online [S/N=3HZ0381E]
Fri Mar 25 23:25:01 2005: /dev/sdb polled at Fri Mar 25 23:25:01 2005 Status:Online [S/N=3FD010LG]
Fri Mar 25 23:25:01 2005: /dev/sdc polled at Fri Mar 25 23:25:01 2005 Status:Online [S/N=3HZ0381E]
Fri Mar 25 23:25:11 2005: /dev/sdb polled at Fri Mar 25 23:25:11 2005 Status:Online [S/N=3FD010LG]
```

(The disk was pulled).

```
Fri Mar 25 23:25:12 2005: /dev/sdc polled at Fri Mar 25 23:25:11 2005 Status:Offline [S/N=3HZ0381E]
Fri Mar 25 23:25:22 2005: /dev/sdb polled at Fri Mar 25 23:25:22 2005 Status:Online [S/N=3FD010LG]
```

Use this command to monitor your hardware to make sure nobody removes peripherals.

1.30 Read Raw Block

This feature was added in release 1.22. It instructs the software to read the selected block(s) from a random access device.

Syntax

`-read s,n,file` Reads n (512-528 byte) blocks from random access device starting at block #s and saves to binary file.

Example:

```
./smartmon-ux -read 0,200,/tmp/First100KBData.bin /dev/sda
```

This will read the first 200 x 512 bytes and save it into the file, assuming the disk is formatted to a standard block size

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of 512 bytes/block. If the disk was formatted to 520 bytes per block then the total number of bytes copied would be 200 x 520 or 104,000

Feature Notes:

- You will get an error message if the range is larger than the number of blocks on the disk. Remember that disk drives start at block zero, so if your disk has 1,000,000,000 blocks, the highest block number you can read is block number 999,999,999.
- The program, by design, does not buffer up the I/O. Only the blocks you request are read from the device. Therefore, this is not an appropriate technique for fast data copy.
- The starting block number and number of blocks are all decimal values (not hex).

1.31 Reassign Physical Sector

This function was introduced in release 1.26.

This function is applicable to disks that use the SCSI protocol only (SCSI, Fibre Channel, SAS, and SSA). If the selected device is SATA or ATA, then the command will be ignored.

Disk drives determine the need to reassign physical sectors based on error activity and mode page settings. Once a physical sector requires assignment, the drive will either reassign the physical sector (block) or recommend to the initiator that the LBA associated with the physical sector be reassigned.

You would use this function to repair unrecovered read errors. It won't be able to get any lost data back, but at least this provides a mechanism to make the problem go away.

Syntax

```
smartmon-ux -rb BLOCKNUMBER device name

- or -

smartmon-ux -rb BLOCKNUMBERh device name
```

where
BLOCKNUMBER is a decimal number for the block number.
BLOCKNUMBERh is a hex number for the block number, ending with the lower-case letter h. Do not put a space between the last hex character and the h. Make sure you enter the block number as a 4-byte or less number.

Examples

```
smartmon-ux -rb 12345678 /dev/sg3
smartmon-ux -rb 7f8ab0h /dev/sg3
```

Only one block can be reassigned at a time, but this is generally not an issue since one would typically only want to reassign one or two blocks. The program will immediately execute and return. If the block can not be reassigned, the disk drive should be replaced (assuming you gave it a block number that really exists on the disk drive).

Below is a table from an IBM manual that shows sense data combinations for recommended reassignment. SANtools does not necessarily endorse this as your needs might be different, but we will say that this information is "reasonable". You should, however, consult your storage vendor for approval. For example, Seagate generally recommends reassignment regardless of the ASCQ value. (All numbers shown in hex).

KEY	ASC	ASCQ	Description
1	16	04	Sync byte error - Recommend Reassignment.
1	17	07	Recovered data without ECC - Recommend Reassignment.
1	18	05	Recovered data with ECC - Recommend Reassignment.
3	11	0B	Unrecovered read error - Recommend Reassignment.
3	16	04	Sync Byte Error - Recommend Reassignment.

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When to Reassign Blocks (SCSI family disks only)

SMARTMon-UX makes it easy for you to know when you have blocks that must be forcibly reassigned. Just run either the self-test (**-steb** 108, or **-scrub** 118 family) commands, and they will report if any blocks have unrecovered errors that should be reassigned.

The advantage of using the **-steb** 108 test is that this is a built-in test and does not consume any host bandwidth. The test can take 30 minutes to several hours depending on the disk drive. This is a built-in test that is initiated by sending a single SCSI command. Once the test is invoked, SMARTMonUX returns and lets you know whether the test was successfully launched. As the test is a background test, it can be run on any and all disk drives, even while I/O is going on. The tests will temporarily suspend to service I/O requests from applications running on your host.

The disadvantage of the **-steb** 108, and **-stsb** 108 tests is that they only report the first bad block found, (**-stsb** 108 might not report any bad blocks) so if you have multiple bad blocks you run the test, reassign, and repeat.

Our **-scrub** 118 family of commands makes a single pass through the disk and returns a list of all blocks that had problems along with the sense information as shown above. This command is also safe to run on your host, but it does consume bandwidth, and the test may also take hours. The -scrub command causes every block in the disk to be read while recording sense information and error codes, which it reports to the operator. He/she will then be able to see all errors and, if required, remap all of them without having to endure multiple passes.

We currently do not provide a mechanism to reassign blocks on SATA / ATA disks.

1.32 Self-Test Diagnostics - ANSI

In release 1.21, we introduced the ability for the user to initiate self-tests. SANtools-specific self-test diagnostics 118 were added in version 1.26. Both have strengths and weaknesses, and you should consider which one (or both) of these tests would be best for you to run in your environment.

Before going further, it is important to understand that the various ANSI specifications for peripherals mandate several types of self-tests. One is mandatory (unless your peripheral is ancient), many are optional. If you send a certain type of self-test to a peripheral that does not support it, then the device is obligated to reject the command. Our software will not tell you ahead of time that a particular device supports a certain self-test function. Well will however, report if it was rejected, or accepted. The ANSI self-test specifications define foreground and background self tests, as well as sort and long self tests that may run for a few seconds to a few hours.

Some self-tests, like a foreground test, will lock up your peripheral while it is running.. Others will affect performance by only a few percentage points. Per the spec, self-tests can be aborted, and you can report ongoing status at any time. Per real-life situations, we have found that some peripherals and firmware revisions do not correctly allow self-tests to be terminated nor do all of them allow the user to request an update while they are running. The SCSI spec. states that the standard self-test is mandatory, and the short and extended self-tests are optional. If your particular device does not support your selected test, the program will notify you after you attempt to initiate the test.

Once smartmon-ux instructs your device to begin the test, our program continues processing other commands which you may have given it. Your device runs the test independently of smartmon-ux and will only end if either the test completes, terminates because an error is found, or you abort the test (via the **-str** command).

Self-Tests for Tapes, Autochangers, and everything but Disk Drives

SMARTMonUX will allow you to run the embedded self-tests that manufacturers include in their firmware. A great number of our customers buy our software so they can do nothing more than test peripherals and tapes on non-windows operating systems.

Self-Tests for Disk and Random-access Devices

If you have SCSI, SAS, or fibre channel disks, then there are no constraints (except under Apple OS X, due to lack of pass-though support for SCSI peripherals). If, however, you have ATA or SATA disk drives, then there are limitations under several operating systems. We provide full support for the native ATA/SATA self-tests under Windows only at

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the time this revision of the manual was placed online. If you need to perform self-tests of ATA/SATA disks on other operating systems, then please contact us for status on extending this function to other operating systems.

SCSI vs. non-SCSI Protocols.

If the selected device is an ATA or SATA disk drive, then the self-test command will end with the letter 'a'. For most self-tests, the concepts are the same whether running a SATA disk drive or a SCSI tape, and the commands are nearly the same.

If you wish to run a background self-test (**`-steb`**, for example) on your boot disk, it is best that you bring the system to single-user mode. This is not a requirement, and we have never crashed our O/S running a bactground self-test on the booted device. As system I/O suspends the self-tests, and self-tests temporarily suspend system I/O, the tests will take significantly longer to complete.

What do Self-tests Do?

The next paragraphs are paraphrased from the SCSI specifications. They will help you understand what self tests are, what they perform, and how they interact with commands sent from the operating system.

The Short and Extended Self-Tests

The short self-test will run in less than two minutes, and it can be used as a sanity check to confirm whether or not a questionable disk is bad. A goal of the extended self-test routine is to simplify factory testing during integration by having devices perform more comprehensive testing without application client intervention. A second goal of the extended self-test is to provide a more comprehensive test to validate the results of a short self-test, if its results are judged by the application client to be inconclusive.

The criteria for the short self-test are that it has one or more segments and completes in two minutes or less. The criteria for the extended self-test are that it is has one or more segments and that the completion time is vendor specific. Any tests performed in the segments are vendor specific.

The following are examples of segments:

- An electrical segment wherein the logical unit tests its own electronics. The tests in this segment are vendor specific, but some examples of tests that may be included are: a buffer RAM test, a read/write circuitry test, and/or a test of the read/write head elements.
- A seek/servo segment wherein a device tests it capability to find and servo on data tracks.
- A read/verify scan segment wherein a device performs read scanning of some or all of the medium surface.

The tests performed in the segments may be the same for the short and extended self-tests. The time required by a logical unit (i.e. SCSI or fibre channel device) to complete its extended self-test is reported via a mode page. Our software will report the estimated time to complete the self-test after you initiate the test. Per the SCSI spec, the extended self-test must complete in two hours or less, and the short test must complete in under two minutes. If you do not have time for the device to finish the test, you may always abort the test. This test time is reported by the device, and not the result of an estimate made by our software, so if the number is not accurate, chances are high you have background I/O attempting to interact with the device while the test was running.

Foreground mode

When the user sends a command specifying a self-test to be performed in the foreground mode, the device server shall return status for that command after the self-test has been completed. While performing a self-test in the foreground mode, the device server shall respond to all commands except INQUIRY, REPORT LUNS, and REQUEST SENSE with a CHECK CONDITION status, a sense key of NOT READY and an additional sense code of LOGICAL UNIT NOT READY, SELF-TEST IN PROGRESS.

If a device server is performing a self-test in the foreground mode and a test segment error occurs during the test, the device server shall update the Self-Test Results log page (reported by **`smartmon-ux -C`**) and report CHECK CONDITION status with a sense key of HARDWARE ERROR and an additional sense code of LOGICAL UNIT FAILED SELF-TEST. The application client may obtain additional information about the failure by reading the Self-Test Results log page. If the device server is unable to update the Self-Test Results log page, it shall return a CHECK CONDITION status with a sense key of HARDWARE ERROR and an additional sense code of LOGICAL UNIT UNABLE TO UPDATE SELF-TEST LOG.

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Note that very few disk drives support the foreground mode.

Background mode

When the self-test runs in the background mode, the device server shall return status for that command as soon as the CDB has been validated. After returning status for the SEND DIAGNOSTICS command specifying a self-test to be performed in the
background mode, the device server shall initialize the Self-Test Results log page. While the device server is performing a self-test in the background mode, it shall terminate with a CHECK CONDITION status any self-test command it receives.

When terminating the SEND DIAGNOSTICS command, the sense key shall be set to NOT READY and the additional sense code shall be set to LOGICAL UNIT NOT READY, SELF-TEST IN PROGRESS. While performing a self-test in the background mode, the device server shall suspend the self-test to service any other commands received with the exceptions listed in table 29. Suspension of the self-test to service the command shall occur as soon as practical and shall not take longer than two seconds.

Table 29 — Exception commands for background self-tests [From ANSI Spec]

Device Type	Command Reference
All device types	SEND DIAGNOSTIC (with SELF-TEST CODE field set to 100b) WRITE BUFFER (with the mode set to any download microcode option)
Direct access (i.e, disks)	• FORMAT UNIT • START/STOP UNIT
Sequential access (i.e. tapes)	• ERASE • FORMAT MEDIUM • LOAD UNLOAD • LOCATE • READ • READ POSITION • READ REVERSE • REWIND • SPACE • VERIFY • WRITE • WRITE BUFFER • WRITE FILEMARKS
Medium Changer	• EXCHANGE MEDIUM • INITIALIZE ELEMENT STATUS • MOVE MEDIUM • POSITION TO ELEMENT • READ ELEMENT STATUS • WRITE BUFFER

Device types not listed in this table do not have commands that are exceptions for background self-tests, other than those listed above for all device types.

If one of the exception commands listed in table 29 is received, the device server shall abort the self-test, update the self-test log, and service the command as soon as practical but not longer than two seconds after the CDB has been validated. An application client may terminate a self-test that is being performed in the background mode by issuing a SEND DIAGNOSTICS command with the SELF-TEST CODE field set to 100b (Abort background self-test function). This corresponds to sending the **`-str`** option with smartmon-ux.

Elements common to foreground and background self-test modes

Although devices report the results of the last twenty most recently completed self-tests, smartmon-ux reports only the last 3 self tests via the **`-C`** option, where it reports the results in human-readable text. If you require the results of the

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last 20 tests, you must manually decode the log page hex dump (**-A** option).

Self-Test Results log page is page 10 hex. Smartmon-ux reports the results and status of the tests based on information from that page.

Table 30 - Self-Test Mode Summary (From ANSI Spec)

Mode	When status is returned	How to abort the test	Processing of subsequent commands while self-test is executing	Self-test failure reporting
Foreground (Not supported with SMARTMon-UX)	After the self-test is complete	N/A - Not supported with smartmon-ux	If command is INQUIRY, REPORT LUNS, or REQUEST SENSE, process normally. Otherwise terminate with CHECK CONDITION status, NOT READY sense key, and LOGICAL UNIT NOT READY, SELF-TEST IN PROGRESS sense code.	Terminate with CHECK CONDITION status, HARDWARE ERROR sense key, and LOGICAL UNIT FAILED SELF-TEST or LOGICAL UNIT UNABLE TO UPDATE SELF-TEST LOG sense code.
Background **-stsb** (short test) **-steb** (extended test) **-stfd** (factory default test)	After the CDB is complete (after **-steb**, **-stfd**, **-stsb** issued)	Send **-sta** command	Process the command with up to 2 second delay.	Send **-str** command to show just self-test results, or **-C** to show all log page results in ASCII, or **-A** to show all log page results in hex
Note: See the SANtools scrub functions 118 which also perform self tests. They may be more appropriate for your requirements.				

Let's look at some program output:

Case 1: Initiate a short background self test, for scsi disk at /dev/sda

```
[root@rh90 smartmon]# ./smartmon-ux -stsb /dev/sda
SMARTMon-ux [Release 1.21, Build 26-JUL-2003] - Copyright 2003 SANtools, Inc. http://www.SANtools.com
Discovered SEAGATE ST373307LC S/N "3HZ0381E" on /dev/sda (SMART enabled)(70007 MB)
 - Initiating short background self-test on SEAGATE ST373307LC at /dev/sda
Terminating program.
```

The test was launched and the program immediately returned to the command-line prompt. Remember, self-tests are performed by the device directly. Once the command is kicked off, control passes back to the operating system.

Case 2: See what is going on, a few seconds after initiating a self-test

```
[root@rh90 smartmon]# ./smartmon-ux -str /dev/sda
SMARTMon-ux [Release 1.21, Build 26-JUL-2003] - Copyright 2003 SANtools, Inc. http://www.SANtools.com
Discovered SEAGATE ST373307LC S/N "3HZ0381E" on /dev/sda (SMART enabled)(70007 MB)
```

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```
 - Results from last self-test: Short background test in progress
Terminating program.
```

The test is still running. Let's wait a few minutes and ask for the results again.

```
[root@rh90 smartmon]# ./smartmon-ux -str /dev/sda
SMARTMon-ux [Release 1.21, Build 26-JUL-2003] - Copyright 2003 SANtools, Inc. http://www.SANtools.com
Discovered SEAGATE ST373307LC S/N "3HZ0381E" on /dev/sda (SMART enabled)(70007 MB)
 - Results from last self-test: Short background test completed w/o error
Terminating program.
```

The test completed without any errors. What can be seen from the **-C** option which reports all log page results? We have truncated part of the output to focus on the part we care about.

```
[root@rh90 smartmon]# ./smartmon-ux -C /dev/sda
SMARTMon-ux [Release 1.21, Build 26-JUL-2003] - Copyright 2003 SANtools, Inc. http://www.SANtools.com
Discovered SEAGATE ST373307LC S/N "3HZ0381E" on /dev/sda (Not Enabling SMART)(70007 MB)
 Statistical log pages dump below [# of bytes reserved for value in device]:
   Logical blocks sent to initiators: 74497749 [4]
   ...
   Self-test (short background): Completed w/o error @ 1769 powered hours
   Self-test (short background): Completed w/o error @ 1765 powered hours
   Self-test (extended background): Completed w/o error @ 1755 powered hours
```

The drive had been powered up for 1769 cumulative hours when the test was completed. The cumulative hours figure is reported by the Seagate disk and not some internal timer running on your operating system or our software. Below is what you would see if you initiated the extended test. The software will start the test and tell you how long the drive reports it will take.

```
[root@rh90 smartmon]# ./smartmon=ux -steb /dev/sda
SMARTMon-ux [Release 1.21, Build 26-JUL-2003] - Copyright 2003 SANtools, Inc. http://www.SANtools.com

Discovered SEAGATE ST373307LC S/N "3HZ0381E" on /dev/sda (SMART enabled)(70007 MB)
 - Initiating extended (25 minutes) background self-test on SEAGATE ST373307LC at /dev/sda
```

Finally, if the self-test failed, you might see something like below:

```
[root@rh90 smartmon]# ./smartmon-ux -str  /dev/sda
SMARTMon-ux [Release 1.21, Build 26-JUL-2003] - Copyright 2003 SANtools, Inc. http://www.SANtools.com
Discovered SEAGATE ST373307LC S/N "3HZ0381E" on /dev/sda (Not Enabling SMART)(70007 MB)
 - Results from last self-test: Short background test FAILED in segment #0 at Block #00000000 000238CFh @ 21
powered hours [Drive media failed] Unrecovered read error ASC=1
1 ASCQ=00, SelfTestByte=00, VendorSpecificByte=E4
```

Self-tests for a SATA Disk Drive Examples

Case 1: Initiate an extended background self test, for a SATA disk running on a Windows XP-64 machine, then look at the results. We are using a disk that has 3 known bad blocks on it.

```
E:\Test1>smartmon-ux -steba \\.\PhysicalDrive1
SMARTMon-UX [Release 1.41, Build  1-NOV-2009] - Copyright 2001-2009 SANtools(R), Inc.
http://www.SANtools.com
Discovered Maxtor 6L100P0 S/N "L23MTW0G" on \\.\PhysicalDrive1 (SMART Enabled)
 The current device temperature is:  43C (109F) degrees
Initiating extended background self-test on Maxtor 6L100P0 S/N "L23MTW0G"

Program Ended.
```

Note, this returned immediately. We then queried the drive to see what happened..

```
E:\Test1>smartmon-ux -stra \\.\PhysicalDrive1
SMARTMon-UX [Release 1.41, Build  1-NOV-2009] - Copyright 2001-2009 SANtools(R), Inc.
http://www.SANtools.com
Discovered Maxtor 6L100P0 S/N "L23MTW0G" on \\.\PhysicalDrive1 (SMART Enabled)
 The current device temperature is:  43C (109F) degrees
```

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```
   Self-test (Short offline) completed - FAILED with read error at block #00000000 00016C0F at 13544 powered
hours
   Self-test (Short offline) completed - FAILED with read error at block #00000000 00016C0F at 13544 powered
hours
   Self-test (Short offline) completed - FAILED with read error at block #00000000 00016C0F at 12810 powered
hours
   Self-test (Short offline) completed - FAILED with read error at block #00000000 00016C0F at 12810 powered
hours
   Self-test (Short offline) completed - FAILED with read error at block #00000000 00016C0F at 12810 powered
hours
   Self-test (Short offline) completed - FAILED with read error at block #00000000 00016C0F at 12810 powered
hours
   Self-test (Extended offline) completed - FAILED with read error at block #00000000 00016C0F at 12809
powered hours

Program Ended.
```

Above also returned immediately. We can see that there is a bad block at hex address 00016C0F. We can also see that this same bad block consistently appears in all of the self-tests we ran while creating this section of the manual.

Now compare with the results of running the **-verify** 165 on the same disk. The **-verify** took nearly 30 minutes, but it returned all 3 bad blocks.

```
smartmon-ux -verify \\.\PhysicalDrive1
SMARTMon-UX [Release 1.41, Build  1-NOV-2009] - Copyright 2001-2009 SANtools(R), Inc. http://www.SANtools.com
Discovered Maxtor 6L100P0 S/N "L23MTW0G" on \\.\PhysicalDrive1 (SMART Enabled)
 The current device temperature is:  39C (102F) degrees

Beginning SANtools read/verify test for Maxtor 6L100P0 at \\.\PhysicalDrive1 (195813072 blocks, blocksize=512)

Read/Verify error summary:
 Event#   PowerOnMins   HexBlockNumber   State   Reassignment Status            AdditionalInfo
      0             -            16c0f   ERR     reassign failed, data invalid  Block 93184 ERR/DEV/STAT:
                                                                                00/F0/51 Error: DRDY, DSC, ERR
      1             -            219a7   ERR     reassign failed, data invalid  Block 137472 ERR/DEV/STAT:
                                                                                00/F0/51 Error: DRDY, DSC, ERR
      2             -            21a19   ERR     reassign failed, data invalid  Block 137728 ERR/DEV/STAT:
                                                                                00/F0/51 Error: DRDY, DSC, ERR
```

Self-Tests FAQ

Q. What are the dangers of running a self-test?

A. Worst-case scenario, if you kick off a foreground self test on the disk that your operating system is booted to, then you will crash your O/S, and your disk will be unresponsive until either the self-test completes or you power cycle the disk. Our software does not care or warn the operator if they run such a test on the boot disk Sometimes this is the only thing you can do if you want to run tests on your boot disk. We will not second-guess you or stand in your way.

At the conclusion of a self-test, then you may have to recycle power on the peripheral, especially if you ran a foreground test. Sometimes the host senses that the peripheral went away, so it stops talking to it. Other times the person(s) who wrote the self-test did it in such a way that requires a power cycle.

Q. What if the self-test locks up and I have to reboot, how do I know if it completed and get results?

A. The results of self-tests are non-volatile. Run **smartmon-ux -stra or -str**, depending on type of peripheral, and it will report the results of the last few self-tests that the device ran.

Q. I have a lot of disks that need testing, can I run multiple self-tests concurrently?

A. Absolutely. In fact, if you run the extended background tests then you can easily test 100 disk drives at the same time with near zero host overhead. The self-tests run inside of the selected peripheral's CPU and firmware. Note that some peripherals unfortunately lock up a peripheral during a self-test, so if this affects your device, then run multiple instances of SMARTMonUX.

Q. Why do self tests and other functions not work on USB and sometimes SATA disks?

A. The most common problem with USB and SATA/ATA disks is that the command isn't getting properly translated to the disk. When you hook up a ATA/SATA device to a USB port, part of the process is that a bridge chip translates the native ATA commands that the disk uses to SCSI commands that the USB protocol uses. The low-level commands

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that run and report self-tests

Q. Can I test tape drives?
A. Yes, absolutely. We have examples in this section of running self-tests on a cartridge tape drive. Remember, the self-test is a feature of the firmware.

Q. I am having problems running self-tests on USB-attached devices, or some SATA disks. What is wrong?
A. The most common problem with USB and SATA/ATA disks is that the command isn't getting properly translated to the disk. When you hook up a ATA/SATA device to a USB port, part of the process is that a bridge chip translates the native ATA commands that the disk uses to SCSI commands that the USB protocol uses. The low-level commands that run and report self-tests are incompatible. Unless the manufacturer of your USB enclosure took great care to properly integrate the necessary translation, then it just won't work. The vast majority of external USB devices will NOT do the translation properly. Don't blame them as they are more concerned with supporting reads & writes. The bottom line is that if you want to perform self-tests on USB mounted peripherals, then you are going to have to hook them up via a native ATA or SATA controller.

There is a similar problem with many of the low-end RAID controllers on motherboards. If your ATA disks appear as SCSI devices, then the RAID controller is performing protocol translation, and their chip may have the same problem Other RAID vendors get around the problem by providing a proprietary programming interface that allows a developer to encapsulate commands so that they work properly.

Q. How does the smartmon-us -verify differ from a self-test?
A. The -verify command will provide you a full list of unreadable blocks. It will not test electronics, or even make sure that the disk can write anything at all. However, unlike the self-test, a self-test will terminate on the first bad block. Furthermore a self-test will not verify the media. It is more likely to never even discover that you have a bad block. If you need to determine if you have unreadable data, then use the -verify command. If you need to do full testing of a disk to make sure it is burned in and safe for use, then run both a -verify, and a self-test, then follow up with the -dft family of commands 123 to perform some destructive write tests.

Q. Can I run self-tests on mounted disk drives?
A. Background tests, per the specification, are not supposed to prevent your host O/S from using the disks concurrently to read and write to. We do this all the time in windows laptops and never have any problems (This does not mean that it is safe, we are just saying we have not had any problems).. However, the safest thing to do before performing tests is to make sure they are not mounted. This allows you to run the potentially more extensive foreground tests. If the disks do not have any data on them, then you can also run destructive tests that verify that the media is OK.

SANtools' official policy is to check with your storage vendor to see if it is 'safe' to run self-tests on systems with live data.

1.33 Secure Erase and Validation

The secure erase function wipes out data on the disk per the US Department of Defense standard DoD 5220.22-M specification. (Note, the specification requires three full triple-pass iterations for DoD compliance). This function is reserved for SCSI, SAS, SSA, and Fibre Channel disks only.

SMARTMon-UX has several commands relating to secure erase:

`-securecheckall`	Scans the entire disk, and reports the count and standard deviation for all 256 possible byte values on the entire disk.
`-securecheck n`	This performs the action in the same way as -securecheck, but it will automatically terminate after either a user-specified amount of time, or after it determines that the data is not random, whichever comes first.
`-secure` 112	This is the function that implements the secure erase.

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Syntax for Secure Erase

smartmon-ux -secure nFullCycles devicename

where **n** is a decimal number from 1-3 which corresponds to the number of full write cycles.

Additional Information

Each cycle corresponds to three full passes where data is written to every addressable block. The first cycle sets every bit to one, the second sets every bit to zero. The final pass in each cycle writes random data. This process can take hours or days to complete, and if you want to insure that your old data is destroyed beyond all ability to recover it, then you should pulverize the disk drive into pieces no larger than a few square millimeters.

Our code takes advantage of specialized commands found in some disk drives to write a pattern to a large number of blocks quickly and efficiently. If your disk drive supports this command, then you will notice that the cycles that set and clear each bit run several times faster than a cycle that randomizes data.

Example

```
C:\scratch>smartmonux-ux -secure 2 \\.\SCSI4Port4Path0Target1Lun0
SMARTMonUX [Release 1.32, Build  12-JAN-2007] - Copyright 2001-2006 SANtools, Inc. http://www.SANtools.com
Discovered IBM DNEF-309170 S/N "AE1J3393" on \\.\SCSI4Port4Path0Target1Lun0 [SES] (Not Enabling SMART)
[Bus/Port/ID.LUN=0/4/1.0](8748 MB)

*******************************************************************************
* Warning:  You have initiated the secure erase function. No checks will be made to    *
*           verify that the disk(s) aren't mounted or in use in any way.               *
*                                                                                      *
*           This will destroy all data on the disk,  and can take hours or possibly    *
*           days to complete.  If you run this test on  a logical disk (i.e, RAID),    *
*           then some data will remain on the disks (metadata & parity data).  If      *
*           the disks are behind a RAID controller then you will need to run this      *
*           software on the individual disk drives.                                    *
*                                                                                      *
*           If you have provided a list of drives to erase, then additional disks will *
*           be erased, one at a time as the process completes for a disk.              *
*                                                                                      *
*           You may specify the total number of passes that will be done. After an     *
*           initial format to clear out data that might be in usable, but formerly     *
*           reallocated sectors, then the software will perform your specified number  *
*           of cycles. Each cycle consists of 3 full write passes.  The first pass     *
*           zeros every bit, then every bit is set to a one.  The third write cycle    *
*           writes random data to the entire disk.                                     *
*******************************************************************************

Are you sure you want to erase the IBM DNEF-309170 disk at \\.\SCSI4Port4Path0Target1Lun0? Answer "YES" to
begin: YES

The US DoD standard for secure erase  specifies 3 iterations (each iteration is 3 passes).  A single
iteration is sufficient to prevent data recovery without forensic recovery equipment, and most users
therefore specify a single iteration.  How many iterations do you wish to perform? (2)): 2

Beginning secure erase where 6 full passes (2 iterations) will be invoked.
Pass #   1: Setting every bit to 0 ...  (Pass time:     9.5m, Total:    9.5m)
Pass #   2: Setting every bit to 1 ...  (Pass time:     9.5m, Total:   19.0m)
Pass #   3: Randomizing every bit ...   (Pass time:    29.6m, Total:   47.6m)
Pass #   4: Setting every bit to 0 ...  (Pass time:     9.5m, Total:   57.1m)
Pass #   5: Setting every bit to 1 ...  (Pass time:     9.5m, Total:   66.6m)
Pass #   6: Randomizing every bit ...   (Pass time:    29.6m, Total:   96.2m)

C:\scratch>
```

(Note: Due to the improved secure erase logic introduced in 1.35, the same disk drive reported the times below. The randomization phases run over twice as fast)

```
Pass #   1: Setting every bit to 0 ...     (Pass time:    9.5m, Total:    9.5m)
Pass #   2: Setting every bit to 1 ...     (Pass time:    9.5m, Total:   18.9m)
```

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```
Pass #   3: Randomizing every bit ...      (Pass time:    9.8m, Total:   28.7m)
Pass #   4: Setting every bit to 0 ...     (Pass time:    9.5m, Total:   38.2m)
Pass #   5: Setting every bit to 1 ...     (Pass time:    9.5m, Total:   47.6m)
Pass #   6: Randomizing every bit ...      (Pass time:    9.7m, Total:   57.3m)
```

Disclaimer

Use this feature at your own risk. SANtools will not guarantee that the secure erase will prevent your data from being recoverable. It is the responsibility of the user to insure that the process completes, and that the appropriate device was selected. If you select logical partitions, LUNs on RAID controllers, or logical disks, then this will not destroy any metadata or redundant data.

In addition, if your disk drives were short stroked (i.e., they present a usable capacity that is smaller then the actual physical capacity to the operating system, then not all of the disk will get erased. If you have any doubts as to whether or not the usable capacity is same as physical capacity, then invoke the command **`-capacity 0`** 28 first. This will resize the disk to the maximum capacity.

Syntax for Secure Check

`smartmon-ux -securecheck n devicename`

where **n** is a decimal number from 1-3 which corresponds to the number of full write cycles.

Additional Information

Each cycle corresponds to three full passes where data is written to every addressable block. The first cycle sets every bit to one, the second sets every bit to zero. The final pass in each cycle writes random data. This process can take hours or days to complete, and if you want to insure that your old data is destroyed beyond all ability to recover it, then you should pulverize the disk drive into pieces no larger than a few square millimeters.

Our code takes advantage of specialized commands found in some disk drives to write a pattern to a large number of blocks quickly and efficiently. If your disk drive supports this command, then you will notice that the cycles that set and clear each bit run several times faster than a cycle that randomizes data.

Example

```
[root@ia64linux smartmon]# ./smartmon-ux -securecheck 1 /dev/sg9
SMARTMon-UX [Release 1.35, Build 18-JAN-2008] - Copyright 2001-2008 SANtools(R), Inc. http://www.SANtools.com
Discovered IBM DNEF-309170 S/N "AJ1P8115" on Device /dev/sg9 (Adapter.Ch/ID.LUN=2.0/7.0) [SES] (Not Enabling SMART)(8748

Beginning SANtools secure erase verification test for IBM DNEF-309170 ...
Test completed.

Report summary:
IO errors for IBM DNEF-309170 at /dev/sg9: No problems found.
```

Byte	Percent	TotalCount	Byte	Percent	TotalCount	Byte	Percent	TotalCount	Byte	Percent	TotalCount
0	96.460	15804	1	0.079	13	2	0.031	5	3	0.000	0
4	0.018	3	5	0.031	5	6	0.024	4	7	0.067	11
8	0.031	5	9	0.006	1	A	0.018	3	B	0.031	5
C	0.006	1	D	0.000	0	E	0.012	2	F	0.000	0
10	0.043	7	11	0.031	5	12	0.000	0	13	0.043	7
14	0.000	0	15	0.000	0	16	0.000	0	17	0.000	0
18	0.006	1	19	0.018	3	1A	0.000	0	1B	0.012	2
1C	0.006	1	1D	0.000	0	1E	0.006	1	1F	0.006	1
20	0.043	7	21	0.006	1	22	0.000	0	23	0.012	2
24	0.006	1	25	0.006	1	26	0.000	0	27	0.000	0
28	0.000	0	29	0.000	0	2A	0.006	1	2B	0.006	1
2C	0.012	2	2D	0.073	12	2E	0.000	0	2F	0.000	0
30	0.067	11	31	0.043	7	32	0.049	8	33	0.018	3
34	0.049	8	35	0.018	3	36	0.049	8	37	0.067	11
38	0.031	5	39	0.043	7	3A	0.000	0	3B	0.000	0
3C	0.006	1	3D	0.000	0	3E	0.012	2	3F	0.018	3
40	0.006	1	41	0.012	2	42	0.018	3	43	0.006	1
44	0.018	3	45	0.012	2	46	0.031	5	47	0.000	0
48	0.006	1	49	0.018	3	4A	0.000	0	4B	0.006	1
4C	0.000	0	4D	0.012	2	4E	0.037	6	4F	0.012	2
50	0.031	5	51	0.006	1	52	0.018	3	53	0.000	0

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54	0.000	0	55	0.024	4	56	0.049	8	57	0.012	2
58	0.000	0	59	0.006	1	5A	0.018	3	5B	0.000	0
5C	0.012	2	5D	0.000	0	5E	0.000	0	5F	0.000	0
60	0.018	3	61	0.116	19	62	0.049	8	63	0.043	7
64	0.067	11	65	0.085	14	66	0.012	2	67	0.031	5
68	0.012	2	69	0.079	13	6A	0.031	5	6B	0.012	2
6C	0.018	3	6D	0.012	2	6E	0.067	11	6F	0.043	7
70	0.031	5	71	0.006	1	72	0.079	13	73	0.073	12
74	0.104	17	75	0.018	3	76	0.024	4	77	0.006	1
78	0.000	0	79	0.012	2	7A	0.000	0	7B	0.000	0
7C	0.031	5	7D	0.006	1	7E	0.018	3	7F	0.000	0
80	0.037	6	81	0.012	2	82	0.000	0	83	0.024	4
84	0.000	0	85	0.000	0	86	0.006	1	87	0.000	0
88	0.006	1	89	0.000	0	8A	0.043	7	8B	0.049	8
8C	0.000	0	8D	0.000	0	8E	0.006	1	8F	0.000	0
90	0.000	0	91	0.000	0	92	0.000	0	93	0.000	0
94	0.000	0	95	0.006	1	96	0.000	0	97	0.000	0
98	0.006	1	99	0.000	0	9A	0.000	0	9B	0.000	0
9C	0.000	0	9D	0.000	0	9E	0.000	0	9F	0.000	0
A0	0.024	4	A1	0.000	0	A2	0.000	0	A3	0.000	0
A4	0.006	1	A5	0.000	0	A6	0.000	0	A7	0.000	0
A8	0.000	0	A9	0.006	1	AA	0.024	4	AB	0.000	0
AC	0.006	1	AD	0.000	0	AE	0.000	0	AF	0.000	0
B0	0.000	0	B1	0.012	2	B2	0.000	0	B3	0.000	0
B4	0.031	5	B5	0.006	1	B6	0.012	2	B7	0.006	1
B8	0.006	1	B9	0.006	1	BA	0.000	0	BB	0.018	3
BC	0.012	2	BD	0.031	5	BE	0.012	2	BF	0.012	2
C0	0.006	1	C1	0.012	2	C2	0.000	0	C3	0.006	1
C4	0.000	0	C5	0.006	1	C6	0.006	1	C7	0.012	2
C8	0.012	2	C9	0.006	1	CA	0.000	0	CB	0.012	2
CC	0.000	0	CD	0.049	8	CE	0.000	0	CF	0.000	0
D0	0.006	1	D1	0.006	1	D2	0.012	2	D3	0.000	0
D4	0.000	0	D5	0.000	0	D6	0.012	2	D7	0.000	0
D8	0.000	0	D9	0.012	2	DA	0.000	0	DB	0.000	0
DC	0.012	2	DD	0.000	0	DE	0.006	1	DF	0.000	0
E0	0.006	1	E1	0.000	0	E2	0.012	2	E3	0.006	1
E4	0.018	3	E5	0.006	1	E6	0.000	0	E7	0.000	0
E8	0.012	2	E9	0.000	0	EA	0.006	1	EB	0.031	5
EC	0.000	0	ED	0.000	0	EE	0.006	1	EF	0.000	0
F0	0.006	1	F1	0.006	1	F2	0.006	1	F3	0.006	1

The **`-securecheckall`** command reported the byte distribution in this manner for the drive.

Byte	Percent	TotalCount	Byte	Percent	TotalCount	Byte	Percent	TotalCount	Byte	Percent	TotalCount
0	90.269	8280514948	1	0.030	2719293	2	0.044	4074225	3	0.044	4073945
4	0.015	1358881	5	0.030	2716384	6	0.015	1358167	7	0.030	2715616
8	0.000	868	9	0.030	2715410	A	0.015	1358393	B	0.074	6787828
C	0.030	2715676	D	0.030	2715813	E	0.074	6787691	F	0.015	1358379
10	0.000	1203	11	0.000	605	12	0.000	1164	13	0.015	1358258
14	0.030	2715650	15	0.015	1358104	16	0.030	2715541	17	0.030	2715050
18	0.000	1278	19	0.074	6788284	1A	0.015	1357602	1B	0.015	1357852
1C	0.044	4072937	1D	0.015	1357721	1E	0.015	1357906	1F	0.030	2715290
20	0.030	2716092	21	0.015	1357644	22	0.044	4072813	23	0.015	1357984
24	0.015	1357950	25	0.015	1357723	26	0.044	4072723	27	0.059	5430210
28	0.000	570	29	0.089	8145178	2A	0.074	6788119	2B	0.030	2715277
2C	0.015	1357971	2D	0.015	1358034	2E	0.059	5429833	2F	0.015	1357848
30	0.044	4073540	31	0.044	4072713	32	0.044	4072990	33	0.015	1358020
34	0.030	2716029	35	0.044	4072693	36	0.059	5430486	37	0.030	2715315
38	0.015	1358122	39	0.015	1358274	3A	0.015	1357727	3B	0.000	784
3C	0.030	2715393	3D	0.015	1358092	3E	0.030	2715660	3F	0.074	6787645
40	0.015	1358068	41	0.000	718	42	0.059	5436035	43	0.044	4073760
44	0.030	2715039	45	0.044	4072566	46	0.030	2715276	47	0.059	5430101
48	0.044	4073455	49	0.030	2715177	4A	0.030	2716231	4B	0.074	6793306
4C	0.030	2721185	4D	0.030	2715280	4E	0.059	5430253	4F	0.030	2715290
50	0.030	2715517	51	0.030	2715034	52	0.059	5430016	53	0.000	326
54	0.030	2715149	55	0.059	5430566	56	0.015	1363791	57	0.030	2715255
58	0.000	811	59	0.015	1357994	5A	2.172	199228412	5B	0.000	301
5C	0.030	2715130	5D	0.015	1357961	5E	0.104	9502348	5F	0.030	2715298
60	0.015	1357801	61	0.044	4072755	62	0.015	1357748	63	0.000	249
64	0.030	2715323	65	0.015	1357799	66	0.059	5431198	67	0.030	2715080
68	0.030	2715396	69	0.059	5429874	6A	0.000	429	6B	0.030	2715268

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 6C   0.030      2715037    6D   0.015      1357720    6E   0.044      4072687    6F   0.044      4072582
 70   0.030      2715555    71   0.000          311    72   0.015      1358155    73   0.015      1357888
 74   0.030      2715167    75   0.030      2715141    76   0.044      4073174    77   0.030      2715669
 78   0.030      2715015    79   0.015      1357848    7A   0.030      2715250    7B   0.030      2715120
 7C   0.030      2715692    7D   0.074      6787384    7E   0.000          425    7F   0.044      4072928
 80   0.059      5430892    81   0.030      2715263    82   0.015      1358505    83   0.074      6787875
 84   0.015      1358134    85   0.030      2715573    86   0.030      2715386    87   0.000          676
 88   0.030      2715552    89   0.015      1358286    8A   0.015      1358115    8B   0.015      1358216
 8C   0.030      2715387    8D   0.059      5430223    8E   0.015      1357855    8F   0.059      5430347
 90   0.015      1358283    91   0.030      2715634    92   0.015      1357964    93   0.000          677
 94   0.030      2715506    95   0.030      2715254    96   0.000          927    97   0.030      2715509
 98   0.000          681    99   0.089      8145415    9A   0.015      1357962    9B   0.030      2715512
 9C   0.000          424    9D   0.015      1357967    9E   0.030      2715632    9F   0.015      1358167
 A0   0.030      2715529    A1   0.030      2716253    A2   0.044      4072789    A3   0.015      1358111
 A4   0.015      1357834    A5   0.000          806    A6   0.044      4072873    A7   0.030      2715252
 A8   0.030      2715509    A9   0.030      2715376    AA   0.044      4073192    AB   0.015      1358090
 AC   0.015      1357850    AD   0.015      1358341    AE   0.000          675    AF   0.030      2715508
 B0   0.030      2715516    B1   0.044      4073173    B2   0.030      2715505    B3   0.015      1358105
 B4   0.015      1358494    B5   0.059      5430338    B6   0.000          699    B7   0.059      5430480
 B8   0.030      2715782    B9   0.015      1358105    BA   0.000          810    BB   0.000          690
 BC   0.030      2715644    BD   0.030      2715779    BE   0.044      4072674    BF   0.044      4072798
 C0   0.044      4073371    C1   0.074      6787786    C2   0.059      5430217    C3   0.044      4072980
 C4   0.030      2715254    C5   0.015      1357964    C6   0.030      2715388    C7   0.015      1358696
 C8   0.030      2715620    C9   0.030      2715778    CA   0.030      2715638    CB   0.059      5430345
 CC   0.044      4072792    CD   0.015      1358239    CE   0.030      2715635    CF   0.000          802
 D0   0.030      2715400    D1   0.000          932    D2   0.044      4072812    D3   0.044      4072795
 D4   0.030      2715506    D5   0.030      2715884    D6   0.059      5430847    D7   0.044      4072670
 D8   0.044      4073186    D9   0.030      2715646    DA   0.015      1357971    DB   0.030      2715383
 DC   0.044      4072798    DD   0.044      4073048    DE   0.000          550    DF   0.015      1358095
 E0   0.030      2715540    E1   0.030      2715485    E2   0.015      1357987    E3   0.059      5430484
 E4   0.030      2715398    E5   0.000          566    E6   0.044      4073310    E7   0.015      1357841
 E8   0.000          745    E9   0.030      2715515    EA   0.030      2715386    EB   0.015      1358124
 EC   0.044      4072794    ED   0.044      4072660    EE   0.015      1357837    EF   0.044      4072670
 F0   0.044      4072834    F1   0.015      1358477    F2   0.059      5430340    F3   0.044      4072951
 F4   0.030      2716624    F5   0.059      5430217    F6   0.015      1358097    F7   0.030      2715287
 F8   0.030      2715542    F9   0.000          596    FA   0.059      5430431    FB   0.030      2715398
 FC   0.059      5430479    FD   0.015      1358236    FE   0.000          710    FF   0.128     11751181

Total bytes analyzed above: 9173114880; on device: 9173114880
Note: The longest consecutive sequence is 38102016 bytes long, and standard deviation is  5.630.
** THIS DISK DOES NOT CONTAIN RANDOM DATA ***
[root@ia64linux smartmon]#
```

This disk must have valid data on it. Notice the large number of zeros and higher percentages of digits 0-9. We run a single-pass secure erase, and then report the results.

```
[root@ia64linux smartmon]# ./smartmon-ux -secure 1 /dev/sg9
SMARTMon-UX [Release 1.35, Build 21-JAN-2008] - Copyright 2001-2008 SANtools(R), Inc.
http://www.SANtools.com
Discovered IBM DNEF-309170 S/N "AJ1P8115" on Device /dev/sg9 (Adapter.Ch/ID.LUN=2.0/7.0) [SES] (SMART
enabled)(8748 MB)

*******************************************************************************
* Warning:  You have initiated the secure erase function. No checks will be made to    *
*           verify that the disk(s) aren't mounted or in use in any way.               *
*                                                                                      *
*           This will destroy all data on the disk,  and can take hours or possibly    *
*           days to complete.  If you run this test on  a logical disk (i.e, RAID),    *
*           then some data will remain on the disks (metadata & parity data).  If      *
*           the disks are behind a RAID controller then you will need to run this      *
*           software on the individual disk drives.                                    *
*                                                                                      *
*           If you have provided a list of drives to erase, then additional disks will *
*           be erased, one at a time as the process completes for a disk.              *
*                                                                                      *
*           You may specify the total number of passes that will be done. After an     *
*           initial format to clear out data that might be in usable, but formerly     *
*           reallocated sectors, then the software will perform your specified number  *
*           of cycles. Each cycle consists of 3 full write passes.  The first pass     *
```

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```
*           zeros every bit, then every bit is set to a one.  The third write cycle    *
*           writes random data to the entire disk.                                      *
*********************************************************************************

Are you sure you want to erase the IBM DNEF-309170 disk at /dev/sg9? Answer "YES" to begin: YES

The US DoD standard for secure erase  specifies 3 iterations (each iteration is 3 passes).  A single
iteration is sufficient to prevent data recovery without forensic recovery equipment, and most users
therefore specify a single iteration.  How many iterations do you wish to perform? (1)): 1

Beginning secure erase where 3 full passes (1 iteration) will be invoked.
Pass #   1: Setting every bit to 0 ...     (Pass time:    9.5m, Total:    9.5m)
Pass #   2: Setting every bit to 1 ...     (Pass time:    9.5m, Total:   18.9m)
Pass #   3: Randomizing every bit ...      (Pass time:   11.5m, Total:   30.4m)
The device has successfully been erased.

0 errors for IBM DNEF-309170 at /dev/sg9: No problems found.
```

Byte	Percent	TotalCount	Byte	Percent	TotalCount	Byte	Percent	TotalCount	Byte	Percent	
0	0.391	35829972	1	0.391	35833545	2	0.391	35828841	3	0.391	35831614
4	0.391	35828018	5	0.391	35845415	6	0.391	35827569	7	0.391	35842468
8	0.391	35829414	9	0.391	35832505	A	0.391	35832274	B	0.391	35829931
C	0.391	35830439	D	0.391	35834870	E	0.391	35839300	F	0.390	35819188
10	0.391	35841614	11	0.391	35829669	12	0.391	35829391	13	0.390	35816735
14	0.391	35832689	15	0.391	35830727	16	0.391	35825645	17	0.391	35830039
18	0.391	35836274	19	0.391	35821265	1A	0.391	35830096	1B	0.391	35822488
1C	0.390	35819790	1D	0.391	35834652	1E	0.391	35828673	1F	0.391	35828992
20	0.391	35825176	21	0.391	35831327	22	0.391	35830549	23	0.391	35836446
24	0.391	35827115	25	0.391	35828167	26	0.391	35836304	27	0.391	35842787
28	0.391	35834765	29	0.391	35835998	2A	0.391	35834606	2B	0.391	35824023
2C	0.391	35825272	2D	0.391	35835496	2E	0.391	35836011	2F	0.390	35811043
30	0.391	35834105	31	0.391	35837830	32	0.391	35835902	33	0.391	35823527
34	0.391	35834823	35	0.391	35829004	36	0.391	35836238	37	0.391	35831478
38	0.391	35839152	39	0.391	35833580	3A	0.391	35834182	3B	0.391	35835355
3C	0.391	35828933	3D	0.391	35840625	3E	0.391	35839028	3F	0.391	35836238
40	0.391	35833824	41	0.391	35840651	42	0.391	35827843	43	0.391	35823703
44	0.391	35825350	45	0.391	35825704	46	0.391	35826986	47	0.391	35826579
48	0.391	35824667	49	0.391	35825018	4A	0.391	35826353	4B	0.391	35832409
4C	0.391	35831285	4D	0.391	35833121	4E	0.391	35833779	4F	0.391	35834653
50	0.391	35826422	51	0.391	35829101	52	0.391	35831170	53	0.391	35839404
54	0.391	35834025	55	0.391	35836547	56	0.391	35839656	57	0.391	35834219
58	0.391	35838322	59	0.391	35842217	5A	0.391	35832608	5B	0.391	35830795
5C	0.391	35830398	5D	0.391	35841648	5E	0.391	35828385	5F	0.391	35843732
60	0.391	35829973	61	0.391	35840043	62	0.391	35834767	63	0.390	35816302
64	0.391	35837421	65	0.391	35828803	66	0.391	35838699	67	0.391	35834395
68	0.391	35829298	69	0.391	35830615	6A	0.391	35835097	6B	0.391	35829154
6C	0.391	35824419	6D	0.391	35831141	6E	0.391	35822070	6F	0.391	35834263
70	0.391	35827148	71	0.391	35837694	72	0.391	35827658	73	0.391	35837475
74	0.391	35828163	75	0.391	35838447	76	0.391	35835951	77	0.390	35817271
78	0.391	35825778	79	0.391	35829808	7A	0.391	35837156	7B	0.391	35834523
7C	0.391	35824324	7D	0.391	35833073	7E	0.391	35830341	7F	0.391	35831459
80	0.391	35842876	81	0.391	35831559	82	0.391	35834054	83	0.391	35832884
84	0.391	35839239	85	0.391	35830311	86	0.391	35827406	87	0.391	35825002
88	0.391	35833267	89	0.391	35828105	8A	0.391	35841893	8B	0.391	35839614
8C	0.391	35824686	8D	0.391	35833548	8E	0.391	35834591	8F	0.391	35839205
90	0.391	35831866	91	0.391	35841088	92	0.391	35846651	93	0.391	35833396
94	0.391	35834672	95	0.391	35835735	96	0.391	35826951	97	0.391	35839477
98	0.391	35831369	99	0.391	35837716	9A	0.391	35831697	9B	0.391	35840650
9C	0.391	35835059	9D	0.391	35826102	9E	0.391	35830481	9F	0.391	35835666
A0	0.391	35825973	A1	0.391	35828942	A2	0.391	35832435	A3	0.391	35828621
A4	0.391	35834144	A5	0.391	35831601	A6	0.391	35828446	A7	0.391	35843438
A8	0.391	35829797	A9	0.391	35824495	AA	0.391	35831540	AB	0.391	35834889
AC	0.391	35832530	AD	0.391	35833245	AE	0.391	35835582	AF	0.391	35830982
B0	0.391	35840199	B1	0.391	35830083	B2	0.391	35832403	B3	0.391	35833307
B4	0.391	35827928	B5	0.391	35843003	B6	0.391	35835190	B7	0.391	35837419
B8	0.391	35824222	B9	0.391	35826359	BA	0.391	35836523	BB	0.391	35834894
BC	0.391	35827413	BD	0.391	35833474	BE	0.391	35839098	BF	0.391	35834938
C0	0.391	35835834	C1	0.391	35842455	C2	0.391	35831998	C3	0.391	35833223
C4	0.391	35821668	C5	0.391	35836508	C6	0.391	35829402	C7	0.391	35829226
C8	0.391	35838460	C9	0.391	35823475	CA	0.391	35845628	CB	0.391	35837043
CC	0.391	35831381	CD	0.391	35831882	CE	0.391	35835077	CF	0.391	35832947
D0	0.391	35837892	D1	0.391	35829781	D2	0.391	35836569	D3	0.391	35841382

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D4	0.391	35828180	D5	0.391	35821680	D6	0.391	35824102	D7	0.391	35844498
D8	0.391	35827409	D9	0.391	35828268	DA	0.391	35840052	DB	0.391	35841451
DC	0.391	35830459	DD	0.391	35835154	DE	0.391	35837332	DF	0.391	35830882
E0	0.391	35828163	E1	0.391	35835412	E2	0.391	35836631	E3	0.391	35835514
E4	0.391	35828177	E5	0.391	35833115	E6	0.391	35828199	E7	0.391	35830728
E8	0.391	35836584	E9	0.391	35831956	EA	0.391	35831583	EB	0.391	35829410
EC	0.391	35822917	ED	0.391	35823825	EE	0.391	35827531	EF	0.391	35835787
F0	0.391	35846811	F1	0.391	35825090	F2	0.391	35832101	F3	0.391	35832957
F4	0.391	35839045	F5	0.391	35850406	F6	0.391	35836066	F7	0.391	35837913
F8	0.391	35831573	F9	0.391	35825461	FA	0.391	35827415	FB	0.391	35841653
FC	0.391	35830668	FD	0.391	35838418	FE	0.391	35834696	FF	0.391	35835358

Total bytes analyzed above: 9173114880; on device: 9173114880
Note: The longest consecutive sequence is 5 bytes long, and standard deviation is 0.000.

Program Ended.

Below is from another analysis and another secure erase pass. Note how well the random number generator distributes 1s and zeros. Each of the 256 possible byte values are written 0.391% of the time, and standard deviation is rounded down to zero. Subsequent passes almost always report the same standard deviation of 0.391% for every byte.

Byte	Percent	TotalCount	Byte	Percent	TotalCount	Byte	Percent	TotalCount	Byte	Percent	TotalCount
0	0.391	35833707	1	0.391	35833028	2	0.391	35833746	3	0.391	35825379
4	0.391	35831376	5	0.391	35838552	6	0.391	35835833	7	0.391	35827386
8	0.391	35836805	9	0.391	35823769	A	0.391	35833986	B	0.391	35824618
C	0.391	35831460	D	0.391	35832262	E	0.391	35828086	F	0.391	35834474
10	0.391	35835466	11	0.391	35838283	12	0.391	35832077	13	0.391	35832956
14	0.391	35833265	15	0.391	35829840	16	0.391	35842722	17	0.391	35829533
18	0.391	35826237	19	0.391	35822378	1A	0.391	35833117	1B	0.391	35831175
1C	0.391	35838283	1D	0.391	35828460	1E	0.391	35839982	1F	0.391	35832747
20	0.391	35827162	21	0.391	35828758	22	0.391	35830946	23	0.391	35836360
24	0.391	35836717	25	0.391	35839408	26	0.391	35821040	27	0.391	35825631
28	0.391	35832739	29	0.391	35832075	2A	0.391	35834083	2B	0.391	35835180
2C	0.391	35839779	2D	0.391	35834717	2E	0.391	35837155	2F	0.391	35828021
30	0.391	35837106	31	0.391	35828067	32	0.391	35825498	33	0.391	35824125
34	0.391	35826869	35	0.391	35831339	36	0.391	35828222	37	0.390	35820030
38	0.391	35830800	39	0.391	35829814	3A	0.391	35832758	3B	0.391	35837251
3C	0.391	35823200	3D	0.391	35829394	3E	0.391	35830338	3F	0.391	35833421
40	0.391	35833429	41	0.391	35834238	42	0.391	35836923	43	0.391	35838558
44	0.391	35839667	45	0.391	35834352	46	0.391	35831685	47	0.391	35836688
48	0.391	35835000	49	0.391	35835931	4A	0.391	35836251	4B	0.391	35839509
4C	0.391	35837401	4D	0.391	35844091	4E	0.391	35829000	4F	0.391	35833787
50	0.391	35826644	51	0.391	35839255	52	0.391	35834924	53	0.391	35823499
54	0.391	35831763	55	0.391	35823681	56	0.391	35838006	57	0.391	35832848
58	0.391	35835740	59	0.391	35824553	5A	0.391	35832107	5B	0.391	35828643
5C	0.391	35831402	5D	0.391	35839455	5E	0.391	35836769	5F	0.391	35833087
60	0.391	35833868	61	0.391	35828431	62	0.391	35829213	63	0.391	35841511
64	0.391	35824372	65	0.391	35828010	66	0.391	35831059	67	0.391	35833943
68	0.391	35839063	69	0.391	35833839	6A	0.391	35821287	6B	0.391	35842340
6C	0.391	35828064	6D	0.391	35831843	6E	0.391	35821119	6F	0.391	35839082
70	0.391	35835218	71	0.391	35828147	72	0.391	35834652	73	0.391	35839950
74	0.391	35834714	75	0.391	35830325	76	0.391	35824354	77	0.390	35819387
78	0.391	35840984	79	0.391	35833362	7A	0.391	35828972	7B	0.390	35820215
7C	0.391	35832008	7D	0.391	35837922	7E	0.391	35840449	7F	0.391	35836522
80	0.391	35838705	81	0.391	35827309	82	0.391	35837329	83	0.391	35832091
84	0.391	35823291	85	0.391	35828190	86	0.391	35831407	87	0.391	35824976
88	0.391	35824871	89	0.391	35824309	8A	0.391	35840238	8B	0.391	35831508
8C	0.391	35828130	8D	0.391	35839372	8E	0.391	35840670	8F	0.391	35822145
90	0.391	35834018	91	0.391	35824506	92	0.391	35834537	93	0.391	35826688
94	0.391	35831448	95	0.391	35840754	96	0.391	35837172	97	0.391	35837407
98	0.391	35842095	99	0.391	35834791	9A	0.391	35830020	9B	0.391	35839427
9C	0.390	35819530	9D	0.391	35830908	9E	0.391	35832220	9F	0.391	35824178
A0	0.391	35833780	A1	0.391	35832884	A2	0.391	35830435	A3	0.391	35837062
A4	0.391	35833475	A5	0.391	35842450	A6	0.391	35843017	A7	0.391	35840131
A8	0.391	35824430	A9	0.391	35827486	AA	0.391	35829485	AB	0.391	35839303
AC	0.391	35835607	AD	0.391	35834223	AE	0.391	35823586	AF	0.390	35811523
B0	0.391	35831265	B1	0.391	35835937	B2	0.391	35826103	B3	0.391	35831500
B4	0.391	35826127	B5	0.391	35826918	B6	0.391	35832064	B7	0.391	35832895

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B8   0.391     35827545    B9   0.391     35825590    BA   0.391     35838479    BB   0.391     35829588
BC   0.391     35832674    BD   0.391     35829762    BE   0.391     35842889    BF   0.391     35831542
C0   0.391     35834933    C1   0.391     35842573    C2   0.391     35828205    C3   0.391     35831076
C4   0.391     35831198    C5   0.391     35831663    C6   0.391     35822112    C7   0.391     35836354
C8   0.391     35838467    C9   0.391     35826302    CA   0.391     35835666    CB   0.391     35839544
CC   0.391     35833268    CD   0.391     35834774    CE   0.391     35827933    CF   0.391     35831123
D0   0.391     35833236    D1   0.391     35835632    D2   0.391     35829711    D3   0.391     35833305
D4   0.391     35833423    D5   0.391     35833328    D6   0.391     35838977    D7   0.391     35838977
D8   0.391     35843830    D9   0.391     35823848    DA   0.391     35839168    DB   0.391     35832321
DC   0.391     35830628    DD   0.391     35838210    DE   0.391     35823853    DF   0.391     35835573
E0   0.391     35830561    E1   0.391     35831060    E2   0.391     35829247    E3   0.391     35824495
E4   0.391     35836808    E5   0.391     35837159    E6   0.391     35838624    E7   0.391     35834402
E8   0.391     35833637    E9   0.391     35830347    EA   0.391     35833533    EB   0.391     35832394
EC   0.391     35825744    ED   0.391     35835509    EE   0.391     35828629    EF   0.391     35821286
F0   0.391     35845849    F1   0.391     35837271    F2   0.391     35831886    F3   0.391     35839247
F4   0.391     35834102    F5   0.391     35841838    F6   0.391     35833509    F7   0.391     35833341
F8   0.391     35835834    F9   0.391     35827056    FA   0.391     35850286    FB   0.391     35826441
FC   0.391     35837663    FD   0.391     35834206    FE   0.391     35834107    FF   0.391     35833501

Total bytes analyzed above: 9173114880; on device: 9173114880
Note: The longest consecutive sequence is 6 bytes long, and standard deviation is  0.000.


Program Ended.
```

1.34 Self-Test Diagnostics - SANtools

We added these commands in response to inefficiencies (and in some case firmware bugs), associated with the built-in self-test functions 105 found in most SCSI and Fibre Channel disk drives. We wanted to provide a tool that would scan the entire disk and produce a report of all errors (or warnings/retries) by block number. The administrator and storage vendor could analyze and correct the most common errors such as unrecoverable read/write errors due to a failed sector without having to re-run the self-test after repairing the next bad block. (Self-tests only report one error, then they stop).

Like the self-tests described in the Self-Test Diagnostics ANSI 105 section, all of these tests are safe to run in a live environment with user I/O running in the background. As the scrubbing self tests described in this section are controlled by the host, there is additional overhead. This overhead is one I/O per 512, 520 or whatever block-size you have times the number of blocks there are on the disk drive. As only one block is read at a time (with -scrub) or only 32 blocks are read at a time with (-scrubq), the test would generally take 30 minutes to several hours to run, even on a system with little overhead.

If you have to test multiple drives, it is best to run multiple instances of the program concurrently. CPU overhead is almost zero. The bottleneck is your disk I/O channel.

Self-Test Commands

`-scrubq` Initiates full media read test, with 32-block chunk size

`-scrub` Initiates full media read test, with 1-block chunk size.

`-scrubr` Pseudo-random read test using SEEK(10 SCSI Command)

`-scrubs` Sequential read fitness test using SEEK(10 SCSI Command)

`-scrubv` May be combined with either option above to set verbose mode so that errors, percentage complete, and remaining time appear as they are discovered.

`-scrubt` This terminates any fitness test on the first error and causes the program to return error code #11 (**SCRUB_T_ERR** 7). The **`-scrubt`** must be combined with the **`-scrub`**, or **`-scrubq`** command.

`-16` May be combined with any of the above options to utilize 16-byte SCSI commands **READ(16)** and **WRITE(16)**

`-12` May be combined with any of the above options to utilize 12-byte SCSI commands **READ(12)** and **WRITE(12)**

.

Notes:

- If **-scrubv** is used without either **-scrubq** or **-scrub**, **-scrubv** will assume **-scrub** was entered and immediately begin the test.

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- All options record errors in the event log, and each error line includes the make/model and device name for the disk as part of that error.
- Only one disk is tested at a time. If you want to test multiple drives concurrently, launch extra instances of the program and point each of them to a different disk or to a different range of disks using wild cards.
- The scrubbing tests are not limited to disk drives. They may be run on optical media such as CD and DVDs, as well as ATAPI (IDE) devices. You would do this in order to perform an optical media certification which would insure that every block of the CD/DVD was readable w/o errors. (If you find a problem, do not bother trying to remap it on a read-only device.
- Running the scrub tests on optical devices would also uncover and report other hardware problems, even if the drives are IDE.
- As of this version of the documentation, we have not tested remapping DVD R/W media in event a defect has been found. It should work, but we do not have means to test this now.
- These tests can be made with peripherals set to any block size, up to 2048 bytes. However, your host operating system or SCSI/Fibre channel controller may not recognize 520-byte or 528-byte formatted disk drives.
- The scrub tests will terminate prematurely after 8190 different blocks report problems.
- Due to limitations in SGI's IRIX operating system that require pass-through I/O to have exclusive access, scrubbing functions typically take 2 - 3 times longer under that O/S. It will have significant system overhead as the device must get opened/closed between hundreds of millions of I/Os. If you use **`-scrubq`**, then the performance impact is minor.
- (The **-16** and **-12** options are mutually exclusive, as are the **-scrubr** and **-scrubs** commands.

Self-Test Characteristics

Test Option	Description	Type of Test / Methodology	Strengths	Weaknesses
-stsb	short background (ANSI-defined test, built into the device's firmware)	• Single command sent, disk runs test for up to 2 minutes, saves result in log page. • Once command is launched by SMARTMonUX, no further interaction required. Unlimited number of disks can be tested concurrently without adversely affecting host system or I/O bandwidth.	• Full test of all except media, but media does have light test. • Completes in less than 2 minutes regardless of host I/O load. • Unlimited instances can be run concurrentl y w/o adverse affect on host.	• Not good for certifying media, but can be combined with **-scrub** for a thorough test (but best to combine **-steb** with **-scrub** for most complete test). • Useless for testing DVD and CDROM media.
-steb	extended background (ANSI-defined test, built into the device's firmware)	• Disk vendors use this as a pass/fail criteria to authorize warranty returns. • Results viewable with **-C** and **-str** commands.	• Tests 100% of disk, including random I/O. • Like the **-stsb**, this test also has no host	• It only returns first error then terminates. • Only way to get a full disk test if you have any errors is to correct problem and

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Test Option	Description	Type of Test / Methodology	Strengths	Weaknesses
			overhead once it is accepted by the disk.	start again. This could take days of operator time if you have multiple errors towards end of a large disk.
-scrub	scrub test	• Reads all blocks on disk and reports sense information resulting from every I/O. • Automatic retries as necessary depending on the errors. • Full report of non-zero sense information and errors/retries	• Single pass-read-everything, returns all errors in report by block number. • Use it to then manually reassign sectors in single pass or to send to storage vendor for analysis for drive replacement.	• No random I/O test. • No non-media tests. • You should combine this test with the -steb to guarantee 100% testing. Run -scrub first and reassign all sectors first so the -steb will not stop when it finds first error.
-scrubq	quick scrub test	• Same as above, but it does 32 blocks at a time to finish test much earlier.	• Does full read, but finishes much faster than **-scrub**. • Use it to quickly find out if there is any sense data indicating drive needs to be replaced or if further action required to repair it.	• Blocks are read in chunks of 32, so sense errors are tied to range of blocks. • You will have to run the **-scrub** or **-steb** options determine exactly what block(s) you need to remap.
-scrubr	random seek test	• Repositions the head in a pseudo-random sequence until one seek has been done for every 16 blocks of data.on the disk. This invokes the SEEK(10)	• This is an important test and successful sequential	• The **-scrubr** & **-scrubs** commands are mutually exclusive.

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Test Option	Description	Type of Test / Methodology	Strengths	Weaknesses
		SCSI CDB.	reads or write tests will not stress the drive arm assembly sufficiently.	You must perform each test separately.
-scrubs	sequential seek test	• Repositions the head from beginning to end of disk using the SEEK(10) SCSI CDB	• Arguably not as useful or stressful on a disk then performing random seeks.	• The **-scrubr** & **-scrubs** commands are mutually exclusive. You must perform each test separately.
-scrubt	terminate on first error	• Terminates any of these self-test diagnostics upon first error	• Self test aborts if problem found, dramatically speeding up process of testing multiple devices.	• Test does not report all errors found and/or repaired.
-scrubv	Verbose scrub	Combine with **-scrub** or **-scrubq** to show results in foreground.	• It shows percentage complete and remaining time.	• Do not redirect output to a file as the file will contain large amount of formatted text and backspace chars.

Example Results

```
[root@BOSS smartmon]# ./smartmon-ux -scrubv -scrub /dev/sg9
SMARTMon-ux [Release 1.26, Build 22-APR-2004] - Copyright 2001-2004 SANtools, Inc. http://www.SANtools.com
Discovered SEAGATE ST373405FC S/N "3EK0V6SG" on /dev/sg9 [SES] (Not Enabling SMART)(70007 MB)
```

(Note percentage complete information and time remaining will appear and automatically update as this procedure progresses. This is not shown below)

```
Beginning SANtools fitness test for SEAGATE ST373405FC at /dev/sg9 (143374740 blocks, blocksize=512)
Block 145614 Sense: 4/32/00 [Controller/drive hardware failed] No defect spare location available
Block 145615 Sense: 3/11/00 [Drive media failed] Unrecovered read error
Block 145616 Sense: 3/11/00 [Drive media failed] Unrecovered read error
Block 145617 Sense: 3/11/00 [Drive media failed] Unrecovered read error
Block 145618 Sense: 4/32/00 [Controller/drive hardware failed] No defect spare location available
Block 145619 Sense: 4/32/00 [Controller/drive hardware failed] No defect spare location available

Block scrubbing error summary:
Block 145614 4/32/00 Count=1 [Controller/drive hardware failed] No defect spare location available
Block 145615 3/11/00 Count=3 [Drive media failed] Unrecovered read error
Block 145616 3/11/00 Count=3 [Drive media failed] Unrecovered read error
Block 145617 3/11/00 Count=3 [Drive media failed] Unrecovered read error
Block 145618 4/32/00 Count=3 [Controller/drive hardware failed] No defect spare location available
Block 145619 4/32/00 Count=2 [Controller/drive hardware failed] No defect spare location available
```

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```
Program Ended.
```

Completion and Test Time

The **-scrub** command reports errors at the block level, by reading each block individually. As such, it sacrifices speed for granularity. Our 146GB 15000RPM SAS disk takes 10 hours to complete using these options. If you don't care about individual block numbers, but still want a count of the bad blocks, then use the **-scrubq** which reads 32 blocks at a time. The same disk that took 10 hours to test with the **-scrubq** command takes 32 minutes to complete.

If you just need a pass-fail test too see if a particular disk has *any* read problems, then be sure to add the **-scrubt** option so that it terminates on the first error. The results below were run on the same disk which has bad blocks which we created with this software on blocks 123 and 456.

Slow, Detailed Report

```
# time /etc/smartmon-ux -scrub /dev/rdsk/c4t15d0s0
SMARTMon-UX [Release 1.36, Build 10-JUN-2008] - Copyright 2001-2008 SANtools(R), Inc. http://www.SANtools.com
Discovered SEAGATE ST3146855SS S/N "3LN29ZZ5" on /dev/rdsk/c4t15d0s0 (Not Enabling SMART)(140014 MB)


Block scrubbing error summary:
Block 123 4/09/00 Count=3 [Controller/drive hardware failed] Track following error
Block 456 4/09/00 Count=3 [Controller/drive hardware failed] Track following error


Program Ended.


real    10h35m40.22s
user    27m8.57s
sys     2h43m53.15s
```

Faster Report

```
# time ./smartmon-ux -scrubq /dev/rdsk/c4t15d0s0
SMARTMon-UX [Release 1.36, Build 10-JUN-2008] - Copyright 2001-2008 SANtools(R), Inc. http://www.SANtools.com
Discovered SEAGATE ST3146855SS S/N "3LN29ZZ5" on /dev/rdsk/c4t15d0s0 (Not Enabling SMART)(140014 MB)


Block scrubbing error summary:
Blocks 96 - 112 4/09/00 Count=3 [Controller/drive hardware failed] Track following error
Blocks 448 - 464 4/09/00 Count=3 [Controller/drive hardware failed] Track following error


Program Ended.
real    32m15.85s
user    2m20.74s
sys     5m18.14s
```

Fastest

```
# time ./smartmon-ux -scrubq -scrubt /dev/rdsk/c4t15d0s0
SMARTMon-UX [Release 1.36, Build 10-JUN-2008] - Copyright 2001-2008 SANtools(R), Inc. http://www.SANtools.com
Discovered SEAGATE ST3146855SS S/N "3LN29ZZ5" on /dev/rdsk/c4t15d0s0 (Not Enabling SMART)(140014 MB)


Block scrubbing error summary:
Blocks 96 - 128 4/09/00 Count=1 [Controller/drive hardware failed] Track following error


real    0m1.67s
user    0m0.00s
sys     0m0.02s
```

If your disks support background media scanning, then you can just ask the disk if it has any problems via the **-bmsr** 217 command (assuming scanning is enabled). This will generate a report based on the last background scan the selected disk ran, and any subsequent activity since that scan. It will take less than a second to report all bad blocks on the disk, regardless of how many you have and where they are located. The disk retains this information through power-cycles.

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```
# time ./smartmon-ux -scrubq -scrubt /dev/rdsk/c4t15d0s0
SMARTMon-UX [Release 1.36, Build 10-JUN-2008] - Copyright 2001-2008 SANtools(R), Inc. http://www.SANtools.com
Discovered SEAGATE ST3146855SS S/N "3LN29ZZ5" on /dev/rdsk/c4t15d0s0 (Not Enabling SMART)(140014 MB)
Background Media Scan Report @ Tue Jun 10 12:18:51 2008
Accumulated power-on minutes:             134911 [94 days]
Number of background scans performed:     37
Background scanning status:               medium scan halted, waiting for interval timer expiration
Background scan percentage completed:     0.00
Defect#   PowerOnMins   HexBlockNumber   State   Reassignment Status            AdditionalInfo
      0           133           37fc7   OK      recovered via in-place rewrite  Recovered error Recovered data with retr
      1        117114         2bf620f   OK      recovered via in-place rewrite  Recovered error Recovered data with retr
      2        130954              7b   ERR     waiting for WRITE               Controller/drive hardware failed Track f
      3        130954             1c8   ERR     waiting for WRITE               Controller/drive hardware failed Track f
      4        130954           37fc7   OK      recovered via in-place rewrite  Recovered error Recovered data with retr
      5        131392           37fc8   OK      recovered via in-place rewrite  Recovered error Recovered data with retr
      6        133380           38039   OK      recovered via in-place rewrite  Recovered error Recovered data with retr
      7        133792         d699104   OK      recovered via in-place rewrite  Recovered error Recovered data with retr
      8        134753          dccde66  OK      recovered via in-place rewrite  Recovered error Recovered data with retr
      9        134755          e2bede7  OK      recovered via in-place rewrite  Recovered error Recovered data with retr

Program Ended.
real    0m0.25s
user    0m0.00s
sys     0m0.02s
```

1.34.1 Data Integrity Test

Release 1.27 introduces two new ***destructive*** integrity tests, **-scrubdi** and **-scrubdiv.** They are used to do a write / read / compare test on every byte of the selected device. The tests are not designed for ATA family disk drives. They are applicable to SCSI, FC random-access devices. (This includes USB memory sticks and optical R/W media). The command will be rejected if you attempt to run it on ATA family disk drives.

These tests were designed with cooperation from RAID controller and subsystem manufacturers. The idea was to create a whole-device data integrity test that would find if there were any situations where the data read back didn't match the data written, or if any I/Os didn't complete without incident the first time they were tried. The reason for the data alignment pattern is to make sure that there was a marker on every block so you could discover if there was a problem that might shift the data left or right a few bits or bytes.

Typical O/S-assisted read/write tests (such as using **`dd if=/dev/zero of=/dev/dsk`**) write the same byte to the target device. If you are writing zeros to every block on a device, then how do you know if anything is skipped, especially if the disk had mostly zeros written to it before you began the test? That is why we designed the test to let you supply a 4-byte pattern, and why we put markers in the data so we know what block number we are supposed to be reading and writing to.

Usage

smartmon-ux -scrubdi [-16 | -12] PATTERN SINGLEYN CHUNKSIZE DeviceName
smartmon-ux -scrubdiv [-16 | -12] PATTERN SINGLEYN CHUNKSIZE DeviceName

The **PATTERN** field must be a 4-byte hex value, as in **`E66EF0F0`**. This pattern will be repeated throughout the device. If you supplied this value then the disk or RW optical media would be written with E6 6E F0 F0 E6 6E ... until the last byte of the device. (Exception is that at the end of every block (typically 512 bytes), the last 8 bytes is going to be a 64-bit value for the current block number. Other things to know about the PATTERN are:

- Assuming you have a disk formatted to the standard 512 byte block size, then bytes #504 - #511 on the first block of the disk would contain 00 00 00 00 00 00 00 00. The last byte of the 2nd block would end with 00 01, the next block ends with 00 02, and so on.
- If your disk drive is formatted on a 520 byte pattern, then this pattern would be written on byte numbers #512 - #519 on every block.
- If you want every block of the disk to be zeroed, with the exception of the end-of-block sequence number, then set the PATTERN to 00000000.

The **SINGLEYN** field can be used to control whether or not the test is done in a single pass. Enter "Y" to instruct the

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software to do the write/read/compare of X blocks, increment block number and continue until end-of-disk. Enter "N" to instruct the software to first write the data on the entire disk sequentially, then do a read/compare sequentially. Due to the performance benefits of caching, then the single-pass version will generally complete faster. As some users might not want the data to be in cache on the read/compare part of the test, we add the SINGLEYN flag as an option.

CHUNKSIZE corresponds to the number of blocks that will be processed in each I/O. The maximum CHUNKSIZE is 64 which would correspond to a 32KB I/O, assuming the standard 512 byte block size. The larger the CHUNKSIZE, the faster the program runs, but this assumes the user wants a large chunk size. As this is not so much a benchmark as a diagnostic routine, we offer the ability to control the chunk size.

The **DeviceName** must be a single device name. No wild-cards are supported in this release. This is because the test is quite destructive. Future revisions of this software may allow wild-cards if customer requests warrant this flexibility.

You may optionally add the -12 or -16 to force the test to attempt to use 12 or 16-byte CDBs. This will provide you with a method which will determine if both your host machine and the target device reports the 12 or 16-byte read and or write commands.

Example

The test below was run on a 256 MB Sony memory stick plugged into a USB port under LINUX.

```
smartmon-ux -scrubdiv E5F5FF00 Y 1 /dev/sg3
SMARTMon-ux [Release 1.27, Build 21-JUN-2004] - Copyright 2001-2004 SANtools, Inc. http://www.SANtools.com
Discovered Sony Storage Media S/N " " on /dev/sg3 (SMART unsupported)(250 MB)

*********************************************************************************
* Warning:  You have instructed the operating system to perform a data integrity       *
*           check on the selected device. No checks will be made to verify that the    *
*           device isn't mounted or in use in any way.                                 *
*                                                                                      *
*           * * *    THIS WILL DESTROY ALL DATA ON THE SELECTED DEVICE    * * *       *
*                                                                                      *
*           The test will write your pattern on every byte of the media, with the      *
*           exception of end-of-block markers in order to perform a data alignment     *
*           test.                                                                      *
*                                                                                      *
*           Please make sure the disk is unmounted before proceeding. This will        *
*           insure that the operating system will not write to the device during       *
*           test which would cause the test to fail.                                   *
*                                                                                      *
*********************************************************************************

The selected device is:"Sony Storage Media at /dev/sg3":
Are you sure you want to do this? Answer "YES" to begin, anything else exits program: YES

Beginning SANtools data integrity test for Sony Storage Media at /dev/sg3 (512000 blocks, blocksize=512,
chunksize=1)
00% (< --- This line is updated after every 1% completion)
Block 0000000Ah Sense: 1/10/00 [Recovered error] CRC or ECC error
Block 0000000Fh Sense: 1/10/00 [Recovered error] CRC or ECC error
100%

SANtools data integrity test (Write Phase) completed for Sony Storage Media at /dev/sg3 with 4 Sense Code
Events: PASSED-WARNINGS
  Block 0000000A 1/10/00 Count=2 [Recovered error] CRC or ECC error
  Block 0000000F 1/10/00 Count=2 [Recovered error] CRC or ECC error

SANtools data integrity test (Verify Phase) completed for Sony Storage Media at /dev/sg3 with 0 Data
Validation (Byte) Errors: PASSED
 Data Validation Test: PASSED
```

In this case, the device returned several recoverable errors during the write phase. This test still passed as all events were recoverable. If there were no events, then the test would have returned the string **PASSED**. If there were any unrecovered errors, then the write phase would have returned **FAILED**. (Unrecovered errors are marked by returned sense key 228 values of 3, 4, 5, 7, 8, and Bh.

Frequently Asked Questions

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What is this test good for?
The data integrity tests are most useful for storage professionals who want to qualify hardware, test RAID controllers, and insure data is in tact after stressing the storage, such as after a controller or HBA fail over test. System administrators should consider running this test in qualifying hardware. You would not ordinarily run this as part of any scheduled maintenance.

What about host overhead?
Generally very low CPU overhead, and high I/O overhead for the device that is being tested. One read or write operation is sent per chunk CHUNKSIZE 124.

Is this a safe operation?
All data is destroyed on the selected device. Use this function wisely.

How long does this take?
This could run all night on a large disk drive. If you run the program in verbose mode, with the `-scrubdiv` 123 flag, then the program will tell you percent complete and remaining time after every 1% of completion.

What do data integrity errors look like?
If the data read is not equal to the data written for any byte, then the software will return specifics of the offset, what was written, and what was read back from the device.

Notes
- These tests make no assumptions about 512-byte block sizes. If the device you wish to test is formatted for 520 or 528 bytes/block, and if your operating system and device drivers have no problems recognizing devices which are not 512 bytes in size, then the software will work as expected.
- Like the -scrub 120 family of commands, these tests are controlled by this software. That means the target device can be any SCSI-family random access device, such as a Read/write DVD, USB memory stick, or disk drive.
- In the event of any non-zero sense key for the write phase, the program will record the error and block number, then retry. After two retries, the program continues. Full details about all errors and warnings are returned with -scrubdiv 123. If you run the -scrubdi 123 version of the test then you only get totals.
- You may add the -16 118 command to force the test(s) to send 16-byte SCSI READ/WRITE commands rather than the 10-byte versions, or add the -12 118 option to send the READ(12) and WRITE(12) commands.

1.35 Self-Test Diagnostics - WRITE SAME

Another feature added to the diagnostic suite in release 1.26 is support for writing data to the entire device. This feature utilizes the SCSI-only WRITE SAME command which instructs the device to fill a block of data with a user-specified pattern. (The command works on SCSI, SAS, SSA, and fibre channel random-access devices. (SMARTMonUX will return an error if you attempt to perform this command on an unsupported device).

Both the **`-wsbyte`** and **`-wsbyteconfirm`** commands initiate the same WRITE SAME function. The **`-wsbyteconfirm`** just suppresses the are-you-sure type message, which allows you to automate this data destructive command. This function will write the pattern starting on block #0 of the disk, and it will continue through the last addressable block. It will not write your pattern on reserved areas, nor will it write the pattern on blocks that may go beyond the reported drive capacity 28. If you need to insure that your pattern writes every addressable block on the disk, then you should send the command, -capacity 0 28 which will reset the disk to maximum addressable capacity.

One would ordinarily use this command variant as part of a automated process. As this test is destructive, we suggest you only use the **`-wsbyteconfirm`** command on systems and scripts that have been fully tested. We also allow you to combine **`-wsbyte`** and **`-confirm`** on the same command-line. These options together are equivalent to the **`-wsbyteconfirm`** command.

Add the optional **`-wsc`** operator if you want the program to immediately terminate the operation after the first error.

Usage

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./smartmon-ux -wsbyte [-16] hexbyte [-wsc] Device_list
./smartmon-ux -wsbyteconfirm [-16] hexbyte [-wsc] Device_list

Where **hexbyte** is the byte that you wish to fill the disk with.

If you want every block of the disk to be zeroed, set **hexbyte** to 00. If you want to write a pattern which would be used as part of a stress disk write test, we have been told that Seagate suggests sending the E6 byte as a pattern.

If you use wild-cards or enter more than one disk in the device list, the program will continue with all disks in the list after the first disk has been written (or skipped by the operator). If there is a problem with flashing any disk, the program immediately terminates with an appropriate error message. (If it is a result of a disk error, sense information will be provided to lend insight into the problem.

(Note, there is no 12-byte version of the WRITE SAME command, so there is no -12 flag).

Example (write E6h pattern to every byte on the disk)

```
[root@rh90 smartmon]# ./smartmon-ux -wsbyte E6 /dev/sg5
SMARTMon-ux [Release 1.26, Build 22-APR-2004] - Copyright 2001-2004 SANtools, Inc. http://www.SANtools.com
Discovered SEAGATE ST336753FC S/N "3HX00LE3" on /dev/sg5 [SES] (Not Enabling SMART)(35003 MB)

*******************************************************************************
* Warning:  You have initiated the WRITE SAME function which instructs this software  *
*           to destroy all of your data and write a single byte pattern over every    *
*           block on the selected disk drive, DESTROYING YOUR DATA.  No checks        *
*           will be made to verify that the disk isn't mounted or in use in any way.  *
*                                                                                     *
*           The process will generally complete in 15 - 30 minutes, and status        *
*           information will appear on the screen as the process progresses.          *
*                                                                                     *
*           Your operating system may attempt to query the disk unless you have       *
*           unmounted it (unassigned drive letter in Windows, umount in UNIX/LINUX).  *
*                                                                                     *
*           If you used a wildcard, or a list of devices, and do not answer YES       *
*           to write data on the disk described below, then it will be skipped and    *
*           the program will select the next disk in the list and repeat this message *
*           until all disks have been skipped or formatted with the supplied byte.    *
*                                                                                     *
*******************************************************************************

This will write the byte E6h across the entire SEAGATE ST336753FC disk at /dev/sg5
Are you sure you want to do this? Answer "YES" to begin the operation, anything else exits program: YES

Beginning WRITE SAME formatting for SEAGATE ST336753FC at /dev/sg5 (71687371 blocks, blocksize=512)
99%    0.1 Mins Remaining  (< --- This line is updated after every 1% completion)

WRITE SAME completed.

Program Ended.
```

Persistent Device Names Warning

Unless your operating system uses persistent device names, you should not automate any tests that are destructive in nature unless there are fail-safes to verify you are performing the action on the device you want to perform the action on. That is because if you add or remove hardware, reboot your machine, the device name for a particular peripheral may change.

Frequently Asked Questions

What is the -wsbyte command good for?

There is generally no faster way to destroy data on your disk (without smashing it into little bits) then by using this command. Since you can also set the byte pattern, you can make multiple passes to prevent data from ever being recovered (except for the types of government agencies that can recover *anything*).

If you are trying to certify a disk drive, or do burn-in, send the E6 pattern with the **-wsbyte** or **-wsbyteconfirm**,

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follow up with the **-scrub** 120 family of read commands, run the **-steb** 108, and repeat. This tests every component of the device including every block of media as well as the electronics components. Seagate recommends using the E6 pattern as it will generally sniff out more weak sectors that would need to be remapped.

What about host overhead?

SMARTMonUX sends only one I/O command to write 30MB at a time. Even measuring this amount of overhead generates a higher load then zeroing your disk. (Note, due to the pass-through I/O limitations unique to SGI's IRIX operating system, the -scrub family of commands will run significantly slower on that platform. (That is because the O/S does not support multiple concurrent pass-through commands to the same device, the handle must be opened & closed between I/Os.). These limitations will not affect the ANSI-type self-test 105 commands, and they will not be noticeable with the write same 125 commands since they might generate only one or two I/Os per second.

Is this a safe operation?

It is safe to do this on any disk other than your O/S disk and any disks required by your O/S, such as swap, to stay alive. Of course, all data will be destroyed on that disk, but it will not hurt the drive. In fact, storage manufacturers use the write-same command as means of stress testing drives to make weak sectors fail so those defects can be remapped.

How long does this take?

A fast 73 GB disk typically completes in around 15 minutes.

How do I test really large devices, like a 5 TB LUN on a RAID controller?

Append the -16 118 function, which instructs the software to send 16-byte SCSI commands. These commands are required for devices greater than the approximately 2.1 TB limitation for the 10-byte SCSI commands.

1.36 Spin Disk Up and Down

These commands are supported on SCSI, SAS, and Fibre Channel Disks. They let you query whether the selected disk is currently spun up, spun down, or in a transitional state.

Spin Up

The **-spinup** command sends the SCSI START UNIT command to the selected disk, which causes it to spin up. If the drive is already spun up, then the command will be ignored. This version of the spin-up command waits for the disk to complete the spin-up process before returning the results.

Reasons for using spin up/down

- You can simulate a type of a drive failure by spinning a disk down, and add delays to benchmarks for situations when you want to see what will happen to some hardware when it is under stress.
- Sometimes JBOD-attached fibre channel disks will spin down if they have not been accessed for a while. Use the spin-up either as a stand-alone command, or a background job to prevent a system from spinning disks down.
- If you have a subsystem that will not be accessed for a while, and your host O/S allows, you can spin it down to conserve power as part of a green initiative.

```
# ./smartmon-ux -spinup /dev/rdsk/c4t16d0s0
SMARTMon-UX [Release 1.36, Build  8-JUN-2008] - Copyright 2001-2008 SANtools(R), Inc. http://www.SANtools.com
Discovered SEAGATE ST3146855SS S/N "3LN27XJ9" on /dev/rdsk/c4t16d0s0 (Not Enabling SMART)(140014 MB)

The disk is now spun up

Program Ended.
```

(The reported results for this and subsequent commands, with exception of the spin inquiry, will be the same regardless of whether the disk is currently up, down, or in a transitional state)

Spin Up Immediate

The **-spinupi** command sends the SCSI START UNIT IMMEDIATE command to the selected disk. Results are similar to START UNIT, but the command is sent to the disk, and does not wait for the drive to spin up before it

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returns.

```
# ./smartmon-ux -spinup /dev/rdsk/c4t16d0s0
SMARTMon-UX [Release 1.36, Build  8-JUN-2008] - Copyright 2001-2008 SANtools(R), Inc. http://www.SANtools.com
Discovered SEAGATE ST3146855SS S/N "3LN27XJ9" on /dev/rdsk/c4t16d0s0 (Not Enabling SMART)(140014 MB)

Successfully instructed the disk to spin up

Program Ended.
```

Spin Down

The **-spindown** command sends the SCSI STOP UNIT command to the selected disk, which causes it to spin down. If the drive is already spun down, then the command will be ignored. This version of the spin-down command waits for the disk to complete the spin-down process before returning the results.

```
# ./smartmon-ux -spindown /dev/rdsk/c4t16d0s0
SMARTMon-UX [Release 1.36, Build  8-JUN-2008] - Copyright 2001-2008 SANtools(R), Inc. http://www.SANtools.com
Discovered SEAGATE ST3146855SS S/N "3LN27XJ9" on /dev/rdsk/c4t16d0s0 (Not Enabling SMART)(140014 MB)

The disk is now spun down

Program Ended.
```

(The reported results for this and subsequent commands, with exception of the spin inquiry, will be the same regardless of whether the disk is currently up, down, or in a transitional state)

Spin Down Immediate

The **-spindowni** command sends the SCSI STOP UNIT IMMEDIATE command to the selected disk. Results are similar to STOP UNIT, but the command is sent to the disk, and does not wait for the drive to spin down before it returns.

```
# ./smartmon-ux -spindowni /dev/rdsk/c4t16d0s0
SMARTMon-UX [Release 1.36, Build  8-JUN-2008] - Copyright 2001-2008 SANtools(R), Inc. http://www.SANtools.com
Discovered SEAGATE ST3146855SS S/N "3LN27XJ9" on /dev/rdsk/c4t16d0s0 (Not Enabling SMART)(140014 MB)

Successfully instructed the disk to spin down

Program Ended.
```

Spin Inquiry

The **-spinq** command queries the disk to see if it is up, down, or transitioning.

```
# ./smartmon-ux -spinq /dev/rdsk/c4t16d0s0
SMARTMon-UX [Release 1.36, Build  8-JUN-2008] - Copyright 2001-2008 SANtools(R), Inc. http://www.SANtools.com
Discovered SEAGATE ST3146855SS S/N "3LN27XJ9" on /dev/rdsk/c4t16d0s0 (Not Enabling SMART)(140014 MB)

The disk is spun up

Program Ended.
```

1.37 Storage Area Network (SAN) Reporting

The **-fc** option is basically just a dump of information about all of the fibre channel HBAs and the devices attached to them. Future releases of the software will expand on the amount of information that is reported, so if you are using a script to interpret the information then you must NOT rely on specific data to be returned on a particular line. UNIX/LINUX users should use **grep** to pattern-match against the title of the field.

As discussed in the Configuring SNIA HBA API Library section 230, the SNIA drivers must be installed on your system for your particular makes and models of HBAs. If they are not properly installed or configured, you would get the results as shown below:

```
[root@morph smartmon]# ./smartmon-ux -fc
```

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```
SMARTMon-ux [Release 1.23, Build 07-DEC-2003] - Copyright 2003 SANtools, Inc.
http://www.SANtools.com
Cannot open /etc/hba.conf
Error loading HBA API library (Error):HBA library version:                    1
 Number of supported adapters:           0

Error unloading HBA API library (Error):[root@morph smartmon]#
[root@morph smartmon]#
```

If this happens, then you probably do not have the drivers loaded. Please consult the online documentation for your HBA supplier and download and install the necessary files. Your HBA firmware may also have to be updated to support the SNIA library, so you should try to read their documentation.

If everything is in order, then you would typically see something like below. The meanings of most of this information should be somewhat obvious. For those fields that make no sense at all to you, chances are good that you would not know what to do with the information now that you have it anyway. If you are having problems then the data would be very useful to your storage subsystem, switch or hub vendors, and your fibre channel HBA vendor.

Here are some results, first from a PC running Windows 2000 ...

```
SMARTMon-ux [Release 1.23, Build  07-DEC-2003] - Copyright 2003 SANtools, Inc. http://www.SANtools.com
 Number of supported adapters:          1
  Adapter #0 Description:               [OK]
   Name:                                QLogic-ql2300-1
   Manufacturer:                        QLogic Corporation
   Serial number:                       J98685
   Model:                               QLA2340
   Model description:                   QLogic QLA2340 PCI Fibre Channel Adapter
   Node WWN:                            20:00:00:E0:8B:0F:1D:3D
   Node symbolic name:
   Hardware version:                    FC5010409-11
   Driver version:                      8.2.3.11 (w32 VI)
   Option ROM version:                  1.34
   Firmware version:                    3.02.14
   VendorSpecific ID:                   1
   Number of ports:                     1
   Driver name:                         ql2300.sys
  Event logging support:                [OK]
   Total number of events:              0
   HBA end port attributes (Device #0): [OK]
    WWN (node name):                    20:00:00:E0:8B:0F:1D:3D
    WWN (port name):                    21:00:00:E0:8B:0F:1D:3D
    WWN (port fabric):
    Number of discovered ports:         0
    FC ID:                              00-00-00
    Type:                               NLPORT (Public Loop)
    State:                              ONLINE
    Supported classes of service:       3
    Supported FC-4 TYPEs:               02010000000000000000000000000000000000000000000000000000000000000000
    Active FC-4 TYPEs:                  00010000000000000000000000000000000000000000000000000000000000000000
    Symbolic port name:
    OS Device name:                     \\.\Scsi2:
    Current speed:                      2 Gbps
    Supported speed(s):                 1, 2 Gbps
    Max frame size:                     2048
   Device Port #0 Statistics:           [OK]
    Seconds since statistics last reset: n/a
    Total frames transmitted:           n/a
    Total words transmitted:            n/a
    Total frames received:              n/a
    Total words received:               n/a
    Total LIP events on arbitrated loop: n/a
    Total NOS events on switched fabric: n/a
    Total error frames:                 n/a
    Total dumped frames:                n/a
    Total link failures:                0
    Total loss of sync:                 1
```

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```
 Total loss of signals:              1
 Total primitive seq protocol errors: 0
 Total invalid trx words:            5
 Total invalid CRCs:                 0
Device Port WWN Details:             22:00:00:04:CF:86:2E:6C
 Device (0) LUN number:              0
  SCSI Inquiry Data:                 [OK]
   Vendor ID:                        SEAGATE
   Product ID:                       ST336753FC
   Revision:                         0002
   Serial Number:                    3HX00LE3
   Serial Number (Page 80h):         3HX00LE300008307WCMY
   Device Identifier (Page 83h):     20000004cf862e6c
  Device capacity (Blocks / GB):     71687371 / 34.18
  Device capacity (LBA Size):        512
 WWN (node name):                    20:00:00:04:CF:86:2E:6C
 WWN (port name):                    22:00:00:04:CF:86:2E:6C
 WWN (port fabric):
 Number of discovered ports:         0
 FC ID:                              00-00-00
 Type:                               UNKNOWN
 State:                              UNKNOWN
 Supported classes of service:
 Supported FC-4 TYPEs:               00000000000000000000000000000000000000000000000000000000000000000000
 Active FC-4 TYPEs:                  00000000000000000000000000000000000000000000000000000000000000000000
 Symbolic port name:
 OS Device name:                     \\.\PhysicalDrive1
 Current speed:                      UNKNOWN
 Supported speed(s):                 UNKNOWN
 Max frame size:                     0
LUN Information for Port WWN:        22:00:00:04:CF:86:2E:6C
 Device (0) LUN number:              0
  SCSI Inquiry Data:                 [OK]
   Vendor ID:                        SEAGATE
   Product ID:                       ST336753FC
   Revision:                         0002
   Serial Number:                    3HX00LE3
   Serial Number (Page 80h):         3HX00LE300008307WCMY
   Device Identifier (Page 83h):     20000004cf862e6c
  Device capacity (Blocks / GB):     71687371 / 34.18
  Device capacity (LBA Size):        512
Device Port WWN Details:             22:00:00:20:37:E6:0A:38
 Device (0) LUN number:              0
  SCSI Inquiry Data:                 [OK]
   Vendor ID:                        SEAGATE
   Product ID:                       ST336605FC
   Revision:                         0003
   Serial Number:                    3FP00BB7
   Serial Number (Page 80h):         3FP00BB700002136H72S
   Device Identifier (Page 83h):     2000002037e60a38
  Device capacity (Blocks / GB):     71132959 / 33.92
  Device capacity (LBA Size):        512
 WWN (node name):                    20:00:00:20:37:E6:0A:38
 WWN (port name):                    22:00:00:20:37:E6:0A:38
 WWN (port fabric):
 Number of discovered ports:         0
 FC ID:                              00-00-00
 Type:                               UNKNOWN
 State:                              UNKNOWN
 Supported classes of service:
 Supported FC-4 TYPEs:               00000000000000000000000000000000000000000000000000000000000000000000
 Active FC-4 TYPEs:                  00000000000000000000000000000000000000000000000000000000000000000000
 Symbolic port name:
 OS Device name:                     \\.\PhysicalDrive2
 Current speed:                      UNKNOWN
 Supported speed(s):                 UNKNOWN
 Max frame size:                     0
LUN Information for Port WWN:        22:00:00:20:37:E6:0A:38
 Device (0) LUN number:              0
  SCSI Inquiry Data:                 [OK]
   Vendor ID:                        SEAGATE
```

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```
   Product ID:                      ST336605FC
   Revision:                        0003
   Serial Number:                   3FP00BB7
   Serial Number (Page 80h):        3FP00BB700002136H72S
   Device Identifier (Page 83h):    2000002037e60a38
  Device capacity (Blocks / GB):    71132959 / 33.92
  Device capacity (LBA Size):       512
Device Port WWN Details:            22:00:00:04:CF:86:2C:94
 Device (0) LUN number:             0
  SCSI Inquiry Data:                [OK]
   Vendor ID:                       SEAGATE
   Product ID:                      ST336753FC
   Revision:                        0002
   Serial Number:                   3HX00TG9
   Serial Number (Page 80h):        3HX00TG900002252EU50
   Device Identifier (Page 83h):    20000004cf862c94
  Device capacity (Blocks / GB):    71687371 / 34.18
  Device capacity (LBA Size):       512
 WWN (node name):                   20:00:00:04:CF:86:2C:94
 WWN (port name):                   22:00:00:04:CF:86:2C:94
 WWN (port fabric):
 Number of discovered ports:        0
 FC ID:                             00-00-00
 Type:                              UNKNOWN
 State:                             UNKNOWN
 Supported classes of service:
 Supported FC-4 TYPEs:              00000000000000000000000000000000000000000000000000000000000000000000
 Active FC-4 TYPEs:                 00000000000000000000000000000000000000000000000000000000000000000000
 Symbolic port name:
 OS Device name:                    \\.\PhysicalDrive3
 Current speed:                     UNKNOWN
 Supported speed(s):                UNKNOWN
 Max frame size:                    0
LUN Information for Port WWN:       22:00:00:04:CF:86:2C:94
 Device (0) LUN number:             0
  SCSI Inquiry Data:                [OK]
   Vendor ID:                       SEAGATE
   Product ID:                      ST336753FC
   Revision:                        0002
   Serial Number:                   3HX00TG9
   Serial Number (Page 80h):        3HX00TG900002252EU50
   Device Identifier (Page 83h):    20000004cf862c94
  Device capacity (Blocks / GB):    71687371 / 34.18
  Device capacity (LBA Size):       512
Device Port WWN Details:            22:00:00:20:37:E6:03:80
 Device (0) LUN number:             0
  SCSI Inquiry Data:                [OK]
   Vendor ID:                       SEAGATE
   Product ID:                      ST336605FC
   Revision:                        0003
   Serial Number:                   3FP008FD
   Serial Number (Page 80h):        3FP008FD00002137H19N
   Device Identifier (Page 83h):    2000002037e60380
  Device capacity (Blocks / GB):    71132959 / 33.92
  Device capacity (LBA Size):       512
 WWN (node name):                   20:00:00:20:37:E6:03:80
 WWN (port name):                   22:00:00:20:37:E6:03:80
 WWN (port fabric):
 Number of discovered ports:        0
 FC ID:                             00-00-00
 Type:                              UNKNOWN
 State:                             UNKNOWN
 Supported classes of service:
 Supported FC-4 TYPEs:              00000000000000000000000000000000000000000000000000000000000000000000
 Active FC-4 TYPEs:                 00000000000000000000000000000000000000000000000000000000000000000000
 Symbolic port name:
 OS Device name:                    \\.\PhysicalDrive4
 Current speed:                     UNKNOWN
 Supported speed(s):                UNKNOWN
 Max frame size:                    0
LUN Information for Port WWN:       22:00:00:20:37:E6:03:80
```

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```
 Device (0) LUN number:              0
  SCSI Inquiry Data:                 [OK]
   Vendor ID:                        SEAGATE
   Product ID:                       ST336605FC
   Revision:                         0003
   Serial Number:                    3FP008FD
   Serial Number (Page 80h):         3FP008FD00002137H19N
   Device Identifier (Page 83h):     2000002037e60380
  Device capacity (Blocks / GB):     71132959 / 33.92
  Device capacity (LBA Size):        512
Device Port WWN Details:             22:00:00:20:37:E6:0B:EF
 Device (0) LUN number:              0
  SCSI Inquiry Data:                 [OK]
   Vendor ID:                        SEAGATE
   Product ID:                       ST336605FC
   Revision:                         0003
   Serial Number:                    3FP00ARC
   Serial Number (Page 80h):         3FP00ARC000021370FWF
   Device Identifier (Page 83h):     2000002037e60bef
  Device capacity (Blocks / GB):     71132959 / 33.92
  Device capacity (LBA Size):        512
 WWN (node name):                    20:00:00:20:37:E6:0B:EF
 WWN (port name):                    22:00:00:20:37:E6:0B:EF
 WWN (port fabric):
 Number of discovered ports:         0
 FC ID:                              00-00-00
 Type:                               UNKNOWN
 State:                              UNKNOWN
 Supported classes of service:
 Supported FC-4 TYPEs:               00000000000000000000000000000000000000000000000000000000000000000000
 Active FC-4 TYPEs:                  00000000000000000000000000000000000000000000000000000000000000000000
 Symbolic port name:
 OS Device name:                     \\.\PhysicalDrive5
 Current speed:                      UNKNOWN
 Supported speed(s):                 UNKNOWN
 Max frame size:                     0
LUN Information for Port WWN:        22:00:00:20:37:E6:0B:EF
 Device (0) LUN number:              0
  SCSI Inquiry Data:                 [OK]
   Vendor ID:                        SEAGATE
   Product ID:                       ST336605FC
   Revision:                         0003
   Serial Number:                    3FP00ARC
   Serial Number (Page 80h):         3FP00ARC000021370FWF
   Device Identifier (Page 83h):     2000002037e60bef
  Device capacity (Blocks / GB):     71132959 / 33.92
  Device capacity (LBA Size):        512
Device Port WWN Details:             22:00:00:20:37:E6:0C:84
 Device (0) LUN number:              0
  SCSI Inquiry Data:                 [OK]
   Vendor ID:                        SEAGATE
   Product ID:                       ST336605FC
   Revision:                         0003
   Serial Number:                    3FP009Y0
   Serial Number (Page 80h):         3FP009Y0000021370FDJ
   Device Identifier (Page 83h):     2000002037e60c84
  Device capacity (Blocks / GB):     71132959 / 33.92
  Device capacity (LBA Size):        512
 WWN (node name):                    20:00:00:20:37:E6:0C:84
 WWN (port name):                    22:00:00:20:37:E6:0C:84
 WWN (port fabric):
 Number of discovered ports:         0
 FC ID:                              00-00-00
 Type:                               UNKNOWN
 State:                              UNKNOWN
 Supported classes of service:
 Supported FC-4 TYPEs:               00000000000000000000000000000000000000000000000000000000000000000000
 Active FC-4 TYPEs:                  00000000000000000000000000000000000000000000000000000000000000000000
 Symbolic port name:
 OS Device name:                     \\.\PhysicalDrive6
 Current speed:                      UNKNOWN
```

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```
 Supported speed(s):                UNKNOWN
 Max frame size:                    0
LUN Information for Port WWN:       22:00:00:20:37:E6:0C:84
 Device (0) LUN number:             0
  SCSI Inquiry Data:                [OK]
   Vendor ID:                       SEAGATE
   Product ID:                      ST336605FC
   Revision:                        0003
   Serial Number:                   3FP009Y0
   Serial Number (Page 80h):        3FP009Y0000021370FDJ
   Device Identifier (Page 83h):    2000002037e60c84
  Device capacity (Blocks / GB):    71132959 / 33.92
  Device capacity (LBA Size):       512
Device Port WWN Details:            22:00:00:80:E5:00:00:00
  SCSI Inquiry Data:                [OK]
   Vendor ID:                       MYLEX
   Product ID:                      FFx2
   Revision:                        5902
   Serial Number:
   Serial Number (Page 80h):
   Device Identifier (Page 83h):    4d59
 WWN (node name):                   20:00:00:80:E5:00:00:00
 WWN (port name):                   22:00:00:80:E5:00:00:00
 WWN (port fabric):
 Number of discovered ports:        0
 FC ID:                             00-00-00
 Type:                              UNKNOWN
 State:                             UNKNOWN
 Supported classes of service:
 Supported FC-4 TYPEs:              00000000000000000000000000000000000000000000000000000000000000000000
 Active FC-4 TYPEs:                 00000000000000000000000000000000000000000000000000000000000000000000
 Symbolic port name:
 OS Device name:
 Current speed:                     UNKNOWN
 Supported speed(s):                UNKNOWN
 Max frame size:                    0
LUN Information for Port WWN:       22:00:00:80:E5:00:00:00
  SCSI Inquiry Data:                [OK]
   Vendor ID:                       MYLEX
   Product ID:                      FFx2
   Revision:                        5902
   Serial Number:
   Serial Number (Page 80h):
   Device Identifier (Page 83h):    4d59
Device Port WWN Details:            22:00:00:80:E5:00:00:01
  SCSI Inquiry Data:                [OK]
   Vendor ID:                       MYLEX
   Product ID:                      FFx2
   Revision:                        5902
   Serial Number:
   Serial Number (Page 80h):
   Device Identifier (Page 83h):    4d59
 WWN (node name):                   20:00:00:80:E5:00:00:01
 WWN (port name):                   22:00:00:80:E5:00:00:01
 WWN (port fabric):
 Number of discovered ports:        0
 FC ID:                             00-00-00
 Type:                              UNKNOWN
 State:                             UNKNOWN
 Supported classes of service:
 Supported FC-4 TYPEs:              00000000000000000000000000000000000000000000000000000000000000000000
 Active FC-4 TYPEs:                 00000000000000000000000000000000000000000000000000000000000000000000
 Symbolic port name:
 OS Device name:
 Current speed:                     UNKNOWN
 Supported speed(s):                UNKNOWN
 Max frame size:                    0
LUN Information for Port WWN:       22:00:00:80:E5:00:00:01
  SCSI Inquiry Data:                [OK]
   Vendor ID:                       MYLEX
   Product ID:                      FFx2
```

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```
      Revision:                         5902
      Serial Number:
      Serial Number (Page 80h):
      Device Identifier (Page 83h):     4d59
   Target Mapping Data:                 (No mappings found)
```

For comparison, below is the output from a PC running Red Hat LINUX 9.0

```
[root@rh90 smartmon]# ./smartmon-ux -fc
SMARTMon-ux [Release 1.23, Build 07-DEC-2003] - Copyright 2003 SANtools, Inc. http://www.SANtools.com
HBA library version:                    2
 Number of supported adapters:          1
  Adapter #0 Description:               [OK]
   Name:                                qlogic-qla2200-0
   Manufacturer:                        Qlogic Corp.
   Serial number:                       A36453
   Model:                               QLA2200
   Model description:                   QLogic QLA2200
   Node WWN:                            20:00:00:E0:8B:00:65:8E
   Node symbolic name:                  QLA2200  HBA Driver
   Hardware version:
   Driver version:                      v.6.01.00-fo
   Option ROM version:                  v.1.83
   Firmware version:                    v. 2.02.03
   VendorSpecific ID:                   0
   Number of ports:                     1
   Driver name:                         qla2200
  Event logging support:                [OK]
   Total number of events:              0
   HBA end port attributes (Device #0): [OK]
    WWN (node name):                    20:00:00:E0:8B:00:65:8E
    WWN (port name):                    21:00:00:E0:8B:00:65:8E
    WWN (port fabric):
    Number of discovered ports:         0
    FC ID:                              00-00-EF
    Type:                               NLPORT (Public Loop)
    State:                              ONLINE
    Supported classes of service:
    Supported FC-4 TYPEs:               00010000000000000000000000000000000000000000000000000000000000000000
    Active FC-4 TYPEs:                  00010000000000000000000000000000000000000000000000000000000000000000
    Symbolic port name:
    OS Device name:                     /proc/scsi/qla2200/1
    Current speed:                      1 Gbps
    Supported speed(s):                 1 Gbps
    Max frame size:                     2048
   Device Port #0 Statistics:           [OK]
    Seconds since statistics last reset: n/a
    Total frames transmitted:           n/a
    Total words transmitted:            n/a
    Total frames received:              n/a
    Total words received:               n/a
    Total LIP events on arbitrated loop: 2
    Total NOS events on switched fabric: n/a
    Total error frames:                 0
    Total dumped frames:                n/a
    Total link failures:                0
    Total loss of sync:                 1
    Total loss of signals:              1
    Total primitive seq protocol errors: 0
    Total invalid trx words:            0
    Total invalid CRCs:                 0
   Device Port WWN Details:             21:00:00:80:E5:11:AB:5C
    Device (0) LUN number:              0
     SCSI Inquiry Data:                 [OK]
      Vendor ID:                        MYLEX
      Product ID:                       DACARMRB
      Revision:                         5902
      Serial Number:
      Serial Number (Page 80h):         0002ab5c20000080e511ab5c0000000000000000
      Device Identifier (Page 83h):     4d594c45582020200002ab5c20000080e511ab5c0000000000000000
```

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```
    Device capacity (Blocks / GB):      142180351 / 67.80
    Device capacity (LBA Size):         512
   Device Port WWN Details:             23:00:00:80:E5:11:BE:66
   Target device mapping (2 devices):
   Device #1 Information:
    OS device name:
    SCSI bus #:                         0
    SCSI target #:                      0
    SCSI LUN #:                         0
    Device Port ID:                     00-00-6E
    Node WWN:                           20:00:00:80:E5:11:AB:5C
    Port WWN:                           21:00:00:80:E5:11:AB:5C
    FCP LUN:                            0h

   Device #2 Information:
    OS device name:
    SCSI bus #:                         0
    SCSI target #:                      1
    SCSI LUN #:                         0
    Device Port ID:                     00-00-6D
    Node WWN:                           20:00:00:80:E5:11:BE:66
    Port WWN:                           23:00:00:80:E5:11:BE:66
    FCP LUN:                            0h
   Persistent Binding:                  (Not supported)
```

Finally, a subset of the information as reported by a SPARC Station running Solaris 8

```
# ./smartmon-ux -fc
SMARTMon-ux [Release 1.23, Build  07-DEC-2003] - Copyright 2003 SANtools, Inc. http://www.SANtools.com
HBA library version:                    2
 Number of supported adapters:          1
  Adapter #0 Description:               [OK]
   Name:                                qlogic-qla2200-0
 Vendor library attributes:
  Version name:                         QLOGIC CORPORATION
  Version number:                       3.05
  Version build date:                   Mon Aug  4 18:43:05 2003
  Final Version:                        Yes
   Manufacturer:                        QLogic Corporation
   Serial number:                       B39680
   Model:                               QLA/QCP/QSB 22xx
   Model description:                   QLogic 1Gb PCI/cPCI/SBus to FC HBA
   Node WWN:                            20:00:00:E0:8B:02:A0:21
   Node symbolic name:                  QLA2200 HBA Driver
   Hardware version:
   Driver version:                      v.4.13
   Option ROM version:                  v.0
   Firmware version:                    v.2.2.6 IP
   VendorSpecific ID:                   0
   Number of ports:                     1
   Driver name:                         qla2200
  Event logging support:                [OK]
   Total number of events:              0
   HBA end port attributes (Device #0):  [OK]
    WWN (node name):                    20:00:00:E0:8B:02:A0:21
    WWN (port name):                    21:00:00:E0:8B:02:A0:21
    WWN (port fabric):
    Number of discovered ports:         0
    FC ID:                              00-00-00
    Type:                               NLPORT (Public Loop)
    State:                              ONLINE
    Supported classes of service:
    Supported FC-4 TYPEs:               00000000000000000000000000000000000000000000000000000000000000000000
    Active FC-4 TYPEs:                  00000000000000000000000000000000000000000000000000000000000000000000
    Symbolic port name:
    OS Device name:                     /devices/pci@1f,0/pci@1/scsi@1:devctl
    Current speed:                      1 Gbps
    Supported speed(s):                 1 Gbps
    Max frame size:                     2048
   Device Port #0 Statistics:           [OK]
    Seconds since statistics last reset: n/a
    Total frames transmitted:           n/a
```

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```
  Total words transmitted:            n/a
  Total frames received:              n/a
  Total words received:               n/a
  Total LIP events on arbitrated loop: n/a
  Total NOS events on switched fabric: n/a
  Total error frames:                 n/a
  Total dumped frames:                n/a
  Total link failures:                1
  Total loss of sync:                 1
  Total loss of signals:              1
  Total primitive seq protocol errors: 0
  Total invalid trx words:            0
  Total invalid CRCs:                 0
Device Port WWN Details:              21:00:00:20:37:E6:93:B2
 Device (0) LUN number:               0
  SCSI Inquiry Data:                  [OK]
   Vendor ID:                         SEAGATE
   Product ID:                        ST336605FC
   Revision:                          0003
   Serial Number:                     3FP011LD
   Serial Number (Page 80h):          3FP011LD00002143DC3F
   Device Identifier (Page 83h):      2000002037e693b2
  Device capacity (Blocks / GB):      71687370 / 34.18
  Device capacity (LBA Size):         512
Device Port WWN Details:              21:00:00:20:37:E6:9F:53
 Device (0) LUN number:               0
  SCSI Inquiry Data:                  [OK]
   Vendor ID:                         SEAGATE
   Product ID:                        ST336605FC
   Revision:                          0004
   Serial Number:                     3FP00Y3T
   Serial Number (Page 80h):          3FP00Y3T00002146J67V
   Device Identifier (Page 83h):      2000002037e69f53
  Device capacity (Blocks / GB):      71687370 / 34.18
  Device capacity (LBA Size):         512
Device Port WWN Details:              21:00:00:20:37:E6:95:1A
 Device (0) LUN number:               0
  SCSI Inquiry Data:                  [OK]
   Vendor ID:                         SEAGATE
   Product ID:                        ST336605FC
   Revision:                          0003
   Serial Number:                     3FP0148W
   Serial Number (Page 80h):          3FP0148W00002147H1BY
   Device Identifier (Page 83h):      2000002037e6951a
  Device capacity (Blocks / GB):      71687370 / 34.18
  Device capacity (LBA Size):         512
Device Port WWN Details:              21:00:00:20:37:E6:08:7D
 Device (0) LUN number:               0
  SCSI Inquiry Data:                  [OK]
   Vendor ID:                         SEAGATE
   Product ID:                        ST336605FC
   Revision:                          0004
   Serial Number:                     3FP00B01
   Serial Number (Page 80h):          3FP00B0100002137H34N
   Device Identifier (Page 83h):      2000002037e6087d
  Device capacity (Blocks / GB):      71132959 / 33.92
  Device capacity (LBA Size):         512
Device Port WWN Details:              21:00:00:20:37:E6:09:3A
 Device (0) LUN number:               0
  SCSI Inquiry Data:                  [OK]
   Vendor ID:                         SEAGATE
   Product ID:                        ST336605FC
   Revision:                          0003
   Serial Number:                     3FP00BJZ
   Serial Number (Page 80h):          3FP00BJZ00002137H2PT
   Device Identifier (Page 83h):      2000002037e6093a
  Device capacity (Blocks / GB):      71132959 / 33.92
  Device capacity (LBA Size):         512
Device Port WWN Details:              21:00:00:20:37:E6:07:3D
 Device (0) LUN number:               0
  SCSI Inquiry Data:                  [OK]
```

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```
   Vendor ID:                      SEAGATE
   Product ID:                     ST336605FC
   Revision:                       0003
   Serial Number:                  3FP00ANW
   Serial Number (Page 80h):       3FP00ANW00002137H2AB
   Device Identifier (Page 83h):   2000002037e6073d
  Device capacity (Blocks / GB):   71132959 / 33.92
  Device capacity (LBA Size):      512
Device Port WWN Details:           21:00:00:20:37:E6:95:A5
 Device (0) LUN number:            0
  SCSI Inquiry Data:               [OK]
   Vendor ID:                      SEAGATE
   Product ID:                     ST336605FC
   Revision:                       0003
   Serial Number:                  3FP017K6
   Serial Number (Page 80h):       3FP017K600002147H14P
   Device Identifier (Page 83h):   2000002037e695a5
  Device capacity (Blocks / GB):   71687370 / 34.18
  Device capacity (LBA Size):      512
Device Port WWN Details:           21:00:00:20:37:E6:09:BE
 Device (0) LUN number:            0
  SCSI Inquiry Data:               [OK]
   Vendor ID:                      SEAGATE
   Product ID:                     ST336605FC
   Revision:                       0003
   Serial Number:                  3FP00B4W
   Serial Number (Page 80h):       3FP00B4W000021370DW8
   Device Identifier (Page 83h):   2000002037e609be
  Device capacity (Blocks / GB):   71132959 / 33.92
  Device capacity (LBA Size):      512
Device Port WWN Details:           21:00:00:04:CF:86:2E:DD
 Device (0) LUN number:            0
  SCSI Inquiry Data:               [OK]
   Vendor ID:                      SEAGATE
   Product ID:                     ST336753FC
   Revision:                       0002
   Serial Number:                  3HX00LDT
   Serial Number (Page 80h):       3HX00LDT00008307WD4Q
   Device Identifier (Page 83h):   20000004cf862edd
  Device capacity (Blocks / GB):   71687371 / 34.18
  Device capacity (LBA Size):      512
Device Port WWN Details:           21:00:00:04:CF:AF:25:FA
 Device (0) LUN number:            0
  SCSI Inquiry Data:               [OK]
   Vendor ID:                      SEAGATE
   Product ID:                     ST373405FC
   Revision:                       0005
   Serial Number:                  3EK1KT8S
   Serial Number (Page 80h):       3EK1KT8S00007303WX06
   Device Identifier (Page 83h):   20000004cfaf25fa
  Device capacity (Blocks / GB):   143374740 / 68.37
  Device capacity (LBA Size):      512
Device Port WWN Details:           21:00:00:04:CF:A4:3D:CD
 Device (0) LUN number:            0
  SCSI Inquiry Data:               [OK]
   Vendor ID:                      SEAGATE
   Product ID:                     ST373405FC
   Revision:                       0005
   Serial Number:                  3EK130Y7
   Serial Number (Page 80h):       3EK130Y700007249ZBDB
   Device Identifier (Page 83h):   20000004cfa43dcd
  Device capacity (Blocks / GB):   143374740 / 68.37
  Device capacity (LBA Size):      512
Device Port WWN Details:           21:00:00:20:37:E6:95:B7
 Device (0) LUN number:            0
  SCSI Inquiry Data:               [OK]
   Vendor ID:                      SEAGATE
   Product ID:                     ST336605FC
   Revision:                       0004
   Serial Number:                  3FP017BV
   Serial Number (Page 80h):       3FP017BV00002147H1GL
```

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```
    Device Identifier (Page 83h):      2000002037e695b7
   Device capacity (Blocks / GB):      71687370 / 34.18
   Device capacity (LBA Size):         512
 Device Port WWN Details:              21:00:00:20:37:E6:03:C3
  Device (0) LUN number:               0
   SCSI Inquiry Data:                  [OK]
    Vendor ID:                         SEAGATE
    Product ID:                        ST336605FC
    Revision:                          0003
    Serial Number:                     3FP008NA
    Serial Number (Page 80h):          3FP008NA00002136H6T9
    Device Identifier (Page 83h):      2000002037e603c3
   Device capacity (Blocks / GB):      71132959 / 33.92
   Device capacity (LBA Size):         512
 Device Port WWN Details:              21:00:00:20:37:E6:0F:48
  Device (0) LUN number:               0
   SCSI Inquiry Data:                  [OK]
    Vendor ID:                         SEAGATE
    Product ID:                        ST336605FC
    Revision:                          0004
    Serial Number:                     3FP00B1P
    Serial Number (Page 80h):          3FP00B1P000021370ES2
    Device Identifier (Page 83h):      2000002037e60f48
   Device capacity (Blocks / GB):      71132959 / 33.92
   Device capacity (LBA Size):         512
 Device Port WWN Details:              21:00:00:20:37:E6:06:31
  Device (0) LUN number:               0
   SCSI Inquiry Data:                  [OK]
    Vendor ID:                         SEAGATE
    Product ID:                        ST336605FC
    Revision:                          0003
    Serial Number:                     3FP009Z6
    Serial Number (Page 80h):          3FP009Z600002137H36P
    Device Identifier (Page 83h):      2000002037e60631
   Device capacity (Blocks / GB):      71132959 / 33.92
   Device capacity (LBA Size):         512
 Target device mapping (15 devices):
 Device #1 Information:
  OS device name:                      /dev/dsk/c1t19d0
  SCSI bus #:                          0
  SCSI target #:                       19
  SCSI LUN #:                          0
  Device Port ID:                      00-00-00
  Node WWN:                            20:00:00:20:37:E6:93:B2
  Port WWN:                            21:00:00:20:37:E6:93:B2
  FCP LUN:                             0h
 Device #2 Information:
  OS device name:                      /dev/dsk/c1t18d0
  SCSI bus #:                          0
  SCSI target #:                       18
  SCSI LUN #:                          0
  Device Port ID:                      00-00-00
  Node WWN:                            20:00:00:20:37:E6:9F:53
  Port WWN:                            21:00:00:20:37:E6:9F:53
  FCP LUN:                             0h
 Device #3 Information:
  OS device name:                      /dev/dsk/c1t17d0
  SCSI bus #:                          0
  SCSI target #:                       17
  SCSI LUN #:                          0
  Device Port ID:                      00-00-00
  Node WWN:                            20:00:00:20:37:E6:95:1A
  Port WWN:                            21:00:00:20:37:E6:95:1A
  FCP LUN:                             0h
 Device #4 Information:
  OS device name:                      /dev/dsk/c1t16d0
  SCSI bus #:                          0
  SCSI target #:                       16
  SCSI LUN #:                          0
  Device Port ID:                      00-00-00
  Node WWN:                            20:00:00:20:37:E6:08:7D
```

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```
 Port WWN:                       21:00:00:20:37:E6:08:7D
 FCP LUN:                        0h
Device #5 Information:
 OS device name:                 /dev/dsk/c1t15d0
 SCSI bus #:                     0
 SCSI target #:                  15
 SCSI LUN #:                     0
 Device Port ID:                 00-00-00
 Node WWN:                       20:00:00:20:37:E6:09:3A
 Port WWN:                       21:00:00:20:37:E6:09:3A
 FCP LUN:                        0h
Device #6 Information:
 OS device name:                 /dev/dsk/c1t14d0
 SCSI bus #:                     0
 SCSI target #:                  14
 SCSI LUN #:                     0
 Device Port ID:                 00-00-00
 Node WWN:                       20:00:00:20:37:E6:07:3D
 Port WWN:                       21:00:00:20:37:E6:07:3D
 FCP LUN:                        0h
Device #7 Information:
 OS device name:                 /dev/dsk/c1t13d0
 SCSI bus #:                     0
 SCSI target #:                  13
 SCSI LUN #:                     0
 Device Port ID:                 00-00-00
 Node WWN:                       20:00:00:20:37:E6:95:A5
 Port WWN:                       21:00:00:20:37:E6:95:A5
 FCP LUN:                        0h
Device #8 Information:
 OS device name:                 /dev/dsk/c1t12d0
 SCSI bus #:                     0
 SCSI target #:                  12
 SCSI LUN #:                     0
 Device Port ID:                 00-00-00
 Node WWN:                       20:00:00:20:37:E6:09:BE
 Port WWN:                       21:00:00:20:37:E6:09:BE
 FCP LUN:                        0h
Device #9 Information:
 OS device name:                 /dev/dsk/c1t11d0
 SCSI bus #:                     0
 SCSI target #:                  11
 SCSI LUN #:                     0
 Device Port ID:                 00-00-00
 Node WWN:                       20:00:00:04:CF:86:2E:DD
 Port WWN:                       21:00:00:04:CF:86:2E:DD
 FCP LUN:                        0h
Device #10 Information:
 OS device name:                 /dev/dsk/c1t9d0
 SCSI bus #:                     0
 SCSI target #:                  9
 SCSI LUN #:                     0
 Device Port ID:                 00-00-00
 Node WWN:                       20:00:00:04:CF:AF:25:FA
 Port WWN:                       21:00:00:04:CF:AF:25:FA
 FCP LUN:                        0h
Device #11 Information:
 OS device name:                 /dev/dsk/c1t8d0
 SCSI bus #:                     0
 SCSI target #:                  8
 SCSI LUN #:                     0
 Device Port ID:                 00-00-00
 Node WWN:                       20:00:00:04:CF:A4:3D:CD
 Port WWN:                       21:00:00:04:CF:A4:3D:CD
 FCP LUN:                        0h
Device #12 Information:
 OS device name:                 /dev/dsk/c1t7d0
 SCSI bus #:                     0
 SCSI target #:                  7
 SCSI LUN #:                     0
 Device Port ID:                 00-00-00
```

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```
   Node WWN:                          20:00:00:20:37:E6:95:B7
   Port WWN:                          21:00:00:20:37:E6:95:B7
   FCP LUN:                           0h
  Device #13 Information:
   OS device name:                    /dev/dsk/c1t6d0
   SCSI bus #:                        0
   SCSI target #:                     6
   SCSI LUN #:                        0
   Device Port ID:                    00-00-00
   Node WWN:                          20:00:00:20:37:E6:03:C3
   Port WWN:                          21:00:00:20:37:E6:03:C3
   FCP LUN:                           0h
  Device #14 Information:
   OS device name:                    /dev/dsk/c1t5d0
   SCSI bus #:                        0
   SCSI target #:                     5
   SCSI LUN #:                        0
   Device Port ID:                    00-00-00
   Node WWN:                          20:00:00:20:37:E6:0F:48
   Port WWN:                          21:00:00:20:37:E6:0F:48
   FCP LUN:                           0h
  Device #15 Information:
   OS device name:                    /dev/dsk/c1t4d0
   SCSI bus #:                        0
   SCSI target #:                     4
   SCSI LUN #:                        0
   Device Port ID:                    00-00-00
   Node WWN:                          20:00:00:20:37:E6:06:31
   Port WWN:                          21:00:00:20:37:E6:06:31
   FCP LUN:                           0h
  Persistent Binding:                 (Not supported)
```

1.38 Storage Area Network (SAN) Device Ping

This function can be equated with a standard TCP/IP ping. It is used to both determine connectivity to a device and to report the amount of milliseconds it takes for a packet of data to get to the device and be acknowledged by it.

Syntax

```
smartmon-ux -fcping PortWWN LUN_Number [Attempts]
```

The LUN_Number would typically be zero for standard disks and tapes. It is quite common to be non-zero for logical disks created by external RAID subsystems.
The PortWWN corresponds to the fibre channel port WWN for the selected device. This information can be obtained by a variety of methods, including:

- Running **smartmon-ux -fc** 128 which will dump all port and WWN info for the devices it can see
- Your HBA management software
- Your operating system's registry or boot logs (i.e., **/vary/log/messages** or **dmesg**)

The optional attempts field is used to tell the program how many attempts it should make. If you enter zero, it will send data indefinitely, or until you abort or kill the program.

Example

```
D:\TEST>smartmon-ux -fcping 22:00:00:20:37:E6:0A:38 0
SMARTMon-ux [Release 1.23, Build 07-DEC-2003] - Copyright 2003 SANtools, Inc.
http://www.SANtools.com
Port 22:00:00:20:37:E6:0A:38 replies in 0.010s as SEAGATE ST336605FC
Port 22:00:00:20:37:E6:0A:38 replies in 0.000s as SEAGATE ST336605FC
Port 22:00:00:20:37:E6:0A:38 replies in 0.000s as SEAGATE ST336605FC

3 successful and 0 unsuccessful pings.
Average ping time: 0.003s.

D:\TEST>smartmon-ux -fcping 22:00:00:20:37:E6:0C:84 0 10
```

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```
SMARTMon-ux [Release 1.23, Build 07-DEC-2003] - Copyright 2003 SANtools, Inc.
http://www.SANtools.com
Port 22:00:00:20:37:E6:0C:84 replies in 0.000s as SEAGATE ST336605FC
Port 22:00:00:20:37:E6:0C:84 replies in 0.000s as SEAGATE ST336605FC
Port 22:00:00:20:37:E6:0C:84 replies in 0.000s as SEAGATE ST336605FC
Port 22:00:00:20:37:E6:0C:84 replies in 0.000s as SEAGATE ST336605FC
Port 22:00:00:20:37:E6:0C:84 replies in 3.044s as SEAGATE ST336605FC
Port 22:00:00:20:37:E6:0C:84 replies in 0.000s as SEAGATE ST336605FC
Port 22:00:00:20:37:E6:0C:84 replies in 0.000s as SEAGATE ST336605FC
Port 22:00:00:20:37:E6:0C:84 replies in 0.000s as SEAGATE ST336605FC
Port 22:00:00:20:37:E6:0C:84 replies in 0.000s as SEAGATE ST336605FC
Port 22:00:00:20:37:E6:0C:84 replies in 0.000s as SEAGATE ST336605FC

10 successful and 0 unsuccessful pings.
Average ping time: 0.304s.
```

You'll note that the Windows machine above is not very consistent in performance. There was a 3-second delay on the 5th attempt. This is something that the system administrator may wish to investigate.

The following example shows what will happen if you attempt to ping a non-existent device.

```
D:\TEST>smartmon-ux -fcping 22:00:00:20:37:E6:0C:99 0 10
SMARTMon-ux [Release 1.23, Build 07-DEC-2003] - Copyright 2003 SANtools, Inc.
http://www.SANtools.com
Could not find path to LUN #0 at port WWN 22:00:00:20:37:E6:0C:99 from:
  - Adapter Port: QLogic Corporation QLA2340 20:00:00:E0:8B:0F:1D:3D
```

Finally, we're pinging the disk subsystem from the SPARCStation. You will note that the operating system does not affect the syntax of the results.

```
# ./smartmon-ux -fcping 21:00:00:20:37:E6:06:31 0 10
SMARTMon-ux [Release 1.23, Build 07-DEC-2003] - Copyright 2003 SANtools, Inc.
http://www.SANtools.com
Port 21:00:00:20:37:E6:06:31 replies in 0.010s as SEAGATE ST336605FC
Port 21:00:00:20:37:E6:06:31 replies in 0.010s as SEAGATE ST336605FC
Port 21:00:00:20:37:E6:06:31 replies in 0.010s as SEAGATE ST336605FC
Port 21:00:00:20:37:E6:06:31 replies in 0.010s as SEAGATE ST336605FC
Port 21:00:00:20:37:E6:06:31 replies in 0.010s as SEAGATE ST336605FC
Port 21:00:00:20:37:E6:06:31 replies in 0.010s as SEAGATE ST336605FC
Port 21:00:00:20:37:E6:06:31 replies in 0.010s as SEAGATE ST336605FC
Port 21:00:00:20:37:E6:06:31 replies in 0.010s as SEAGATE ST336605FC
Port 21:00:00:20:37:E6:06:31 replies in 0.010s as SEAGATE ST336605FC
Port 21:00:00:20:37:E6:06:31 replies in 0.010s as SEAGATE ST336605FC

10 successful and 0 unsuccessful pings.
Average ping time: 0.010s.
```

Additional Information

A few things to know about this feature.

- The granularity of the ping is measured and reported in milliseconds.
- The program sleeps for 1000 milliseconds (1 second) between each ping attempt, whether successful or unsuccessful.
- SMARTMon-UX will not let you ping a port name that is not known to the HBA. This is by design, as we have seen the Q-Logic library lock up on LINUX in testing when we attempted to ping a device which does not exist.
- All of this information is obtained by communicating directly with your HBA through the SNIA API library. On more than one occasion we have seen incorrect results returned by HBAs. Some times updating the HBA firmware and drivers to the latest release fixed the problem. Other times the bad data is unique to a particular HBA model, firmware revision, and operating system.

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- We have sometimes seen that the HBA never responds, or that the program will lock up (but not your computer) when using the **-fc** 128 or **-fcping** 140 commands. This is due to bugs in the API, or not having the latest firmware and/or drivers for your HBA loaded. Please report this information both to us, and to your HBA supplier to get them resolved. Often, if you just upgrade to the most current HBA drivers then the problems and lockups go away.

1.39 Storage Area Network (SAN) HBA Info

Use the -fchbainfo command to report information specific to the make, model, and drivers for your fibre channel HBA(s). Unlike the -fc command, this does not search for devices attached to the HBAs. It just reports information specific to the HBAs installed in your system.

Example:

```
[root@BOSS smartmon]# ./smartmon-ux -fchbainfo
SMARTMon-ux [Release 1.23D, Build  7-JAN-2004] - Copyright 2001-2004 SANtools, Inc. http://www.SANtools.com
 Number of supported adapters:          2
  Adapter #0 Description:               [OK]
   Name:                                Emulex-LP8000-1
   Manufacturer:                        Emulex Corporation
   Serial number:                       0000c92304fe
   Model:                               LP8000
   Model description:                   Emulex LightPulse LP8000 1 Gigabit PCI Fibre Channel Adapter
   Node WWN:                            20:00:00:00:C9:23:04:FE
   Node symbolic name:
   Hardware version:                    2002506d
   Driver version:                      4.30l; HBAAPI v1.4, 11-19-02
   Option ROM version:
   Firmware version:                    3.91A3
   VendorSpecific ID:                   F80010DFh
   Number of ports:                     1
   Driver name:                         lpfcdd
   IP Unit Type:                        07h (HBA)
   Port ID:                             00h
   Number Of Attached Nodes:            0
   IP Version:                          01h (IPV4)
   UDPPort:                             00h
   IP Address:                          0.0.0.0
   Discovery Flags:                     00h ()

  Adapter #1 Description:               [OK]
   Name:                                qlogic-qla2300-0
   Manufacturer:                        Qlogic Corp.
   Serial number:                       J98648
   Model:                               QLA2312
   Model description:                   QLogic QLA2312
   Node WWN:                            20:00:00:E0:8B:0F:F8:3C
   Node symbolic name:                  QLA2312  HBA Driver
   Hardware version:                    FC5010409-11
   Driver version:                      v.6.01.00-fo
   Option ROM version:                  v.1.34
   Firmware version:                    v. 3.01.13
   VendorSpecific ID:                   0h
   Number of ports:                     1
   Driver name:                         qla2300
```

Notes:

- If you have an HBA that does not appear, then check to see that the vendor's SNIA API Library is properly installed and configured on your system. Remember, there is an HBAAPI runtime, which is common to all HBAs, and there are vendor/HBA-unique library files that have to be installed and referenced in the /etc/hba.conf 235 file or your Windows registry.
- SMARTMonUX and the SNIA HBA API both report mixing and matching HBA vendors, models, and firmware. That does not mean that your HBA vendors support "foreign" HBA vendor cards and/or drivers.

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1.40 Storage Area Network (SAN) I/O Stat

This function can be equated with the standard Unix **iostat** program. It is designed to show throughput and errors measured at each fibre channel controller port. This feature does not issue any I/Os to any fibre channel peripherals. It just queries your local HBAs via the SNIA HBA API library for cumulative totals it maintains.

Syntax:

```
smartmon-ux -fciostat [-h] [-k] [-r] [-t] [-x] [-?] [<interval>] [<count>]
```

Where:

-h	Suppress descriptive headers between each polling interval
-k	Convert words transmitted and received to kilobytes/sec (each word is 4 bytes long)
-r	Display raw values (do not calculate totals over time)
-t	Display timestamp column
-x	Display Extended statistical data columns.
-?	Displays Usage and header information. This must be only option after **-fciostat**
interval	Period in seconds between each poll. If you do not enter an interval, program will display cumulative totals
count	Number of iterations program should perform before exiting. This must be used in conjunction with an interval.

Example #1: Display Usage and Headers

```
./smartmon-ux -fciostat -?
SMARTMon-ux [Release 1.24, Build 25-JAN-2004] - Copyright 2001-2004 SANtools, Inc. http://www.SANtools.com
Usage:  ./smartmon-ux -fciostat [ options...] [ <interval> ] [ <count> ]
   Options are:
    -h  Suppress extra headers between each polling period
    -k  Display stats in KB/sec (1 KB = 1000 Bytes)
    -r  Display raw rules (don't calculate totals over time)
    -t  Display timestamp
    -x  Display extended information
    -?  Display help information
  <interval> = seconds between each poll
  <count>    = number of iterations before exiting
   Legend:
      tps     Transactions per second (Total frames transmitted & received)
  Tx_Fr/s     Transmitted frames per second
  Rx_Fr/s     Received frames per second
  Words_T     Words (4 bytes each) transmitted
  Words_R     Words (4 bytes each) received
     LIPs     LIP events on arbitrated loop
     NOSs     NOS events on switched fabric
     Errs     Error frames
    DumpF     Dumped frames
    LinkF     Link failures
    SyncF     Loss of SYNCs
    SignF     Loss of signals
    ProtE     Primitive sequential protocol errors
     TrxE     Invalid transmission words
     CRCE     Invalid CRCs
 Note - Not all HBAs and/or HBA drivers support reporting any or all of this information
```

Example #2: Poll and report totals every 10 seconds.

This is how the **fciostat** will normally be used. The fields shown **in blue** are the ones that only appear if the **-x** 143 (for extended) flag is selected. Comments are in **{violet}**

```
smartmon-ux -fciostat -k -x -t -h 10
SMARTMon-ux [Release 1.23D, Build  7-JAN-2004] - Copyright 2001-2004 SANtools, Inc. http://www.SANtools.com
Linux 2.4.9-18smp (Itanium.sanmanager.com)     01/07/04  {O/S version followed by fully qualified host name,
then date}
```

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```
Device:                      Time          tps      Tx_Fr/s      Rx_Fr/s       KB_T/s      KB_Rx/s  LIPs
NOSs  Errs DumpF LinkF SyncF SignF ProtE  TrxE  CRCE
Emulex-LP8000-1           21:10:37       7209.3       6227.0       982.26       998.91        10611     1
n/a     0   n/a     0     8     0     0     1     0
qlogic-qla2300-0          21:10:37          n/a          n/a          n/a          n/a          n/a     0
n/a     1   n/a     1     0    30     0    28     0
Emulex-LP8000-1           21:10:48       1813.3       1101.0       712.24       1067.3       1082.7     0
n/a     0   n/a     0     0     0     0     0     0
qlogic-qla2300-0          21:10:48          n/a          n/a          n/a          n/a          n/a     0
n/a     0   n/a     0     0     0     0     0     0
Emulex-LP8000-1           21:10:57        923.03       803.98       119.05       6.6533       1160.9     0
n/a     0   n/a     0     0     0     0     0     0
qlogic-qla2300-0          21:10:57          n/a          n/a          n/a          n/a          n/a     0
n/a     0   n/a     0     0     0     0     0     0
Emulex-LP8000-1           21:11:07        511.34       340.93       170.41       9.6208       184.74     0
n/a     0   n/a     0     0     0     0     0     0
...
```

Notes:

- Unfortunately not all models of HBAs monitor and/or report all statistical data information defined by the SNIA specification. In general, many models of Q-Logic HBAs do not maintain statistical totals for words and frames transmitted and received. The Emulex and JNI HBAs usually report all but a few fields. SMARTMonUX will display n/a or leave fields blank, rather than report zeros for information that is not available.
- If your HBA does not report some statistical data fields, you should check the HBA BIOS and/or firmware revision to see if they are current. If not, update the drivers. We discovered that Emulex LP8000s would report throughput information once the firmware was upgraded. You can use the **-fchbainfo** 142 option to see the firmware revision of your HBAs.
- If your HBA does not report the throughput fields, and you do not specify the **-x** 143 option to view extended information, then SMARTMonUX will suppress displaying of data for that particular HBA after the first poll.

1.41 Tape Drive Testing and Optimization

SANtools software is uniquely qualified to empower you to diagnose and treat tape performance and reliability issues you probably didn't even know you have. This section shows a subset if information taken from a tandberg tape drive using our software and covers some things that administrators should consider when maintaining tapes. The information below is taken from other pages in the documentation, and summarized below for your convenience.

Firmware Updates

You should always check to insure you have current firmware. Enter smartmon-ux -I+ 62 to report details about your tape subsystem that will make it easy for you to determine what firmware you are running (and often how old it is). For this particular model of tape, we are also able to report that the firmware was written on 07/02/2003, and the tape drive was manufactured back in 2001. It has never had a factory adjustment.

```
Vendor Identification:              TANDBERG
Product Identification:             SLR7
Firmware Revision:                  0595
Drive manufacturing MM.DD.YY:       06.12.01
Main microcode creation MM.DD.YY:   07.02.03
DSP microcode creation MM.DD.YY:    07.02.03
Last drive adjustment MM.DD.YY:     ........
```

If your firmware is old, and you are lucky, then your manufacturer has a program that you can run to upgrade the firmware. 99% of the time, the program is written exclusively for Windows. Our tandberg was attached to our in-house Sun, and Tandberg does not distribute a program that lets you upgrade firmware 47 under anything but 32-bit windows. The firmware that this tape is now running, version 595, was upgraded on our sun by entering **`smartmon-ux -flash S07d0595.bin`**. (Release 1.42 removed the artificial constraint that limited firmware flashing to SCSI/SAS/FC disk drives and SES enclosures. You can now flash any peripheral that uses the SCSI protocol. Keep in mind, however, that manufacturers sometimes add a "wrapper" to firmware files that requires you to flash using the manufacturer's utility. You should always contact your manufacturer before flashing firmware upgrades. We will be happy to work with them to qualify our software for firmware updates .. especially if the manufacturer can not help you with non-windows hosts.

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Compression Efficiency

Hardware or software compression, which is best? How do you tell if hardware compression is enabled on the tape drive? (See the DCE setting 145) The answer is that it depends. Our software will provide you the tools you need to measure true compression, compare different algorithms (if your tape is equipped), and see if your tape operates more efficiently using one method or another. The information below comes from viewing the log pages after a backup run. Further down, you will see some configurable mode pages parameters and settings.

Just run **smartmon-ux -Cx** 71 before and after a test run, and use the results to establish effectiveness of your settings down to the exact byte count.

```
Total logical data blocks transferred: 7248
Total physical blocks written to media: 55023104
Total physical blocks read from media (Read and Space operations only): 101376
Write compression ratio (percentage - reset on cartridge change): 168
Read compression ratio (percentage - reset on cartridge change): 0
Percentage of data with compression between .89 and 1.2 - reset on cartridge change: 0
Percentage of data with compression between 1.2 and 1.6 - reset on cartridge change: 28
Percentage of data with compression between 1.6 and 2.2 - reset on cartridge change: 71
Percentage of data with compression between 2.2 and 3.6 - reset on cartridge change: 0
Percentage of data with compression greater than 3.6 - reset on cartridge change: 0
Bytes processed (on Writes): 295436288
Unrecovered errors (on Writes): 0
Bytes processed (on Reads): 7602176
```

Tape Drive Configurable Mode Page Parameters

Our tandberg isn't very configurable (the R/O means the field is read-only), but other manufacturers provide much greater room for tweaking settings. If you read the full manuals for the most popular software, you will find that they usually provide "best practice" settings. You will be amazed at how much your performance may improve if your buffer size is too small or too large, as an example.

```
Read-Write Error Recovery               : Page [01h] (Factory, Current, Saved)
 Transfer block (TB)                    : 0, 0, 0 {R/O}
 Enable early recovery (EER)            : 1, 1, 1 {R/O}
 Post error (PER)                       : 0, 0, 0 {R/O}
 Disable transfer on error (DTE)        : 0, 0, 0 {R/O}
 Disable correction (DCR)               : 0, 0, 0
 Read retry count (RRC)                 : 24, 24, 24
 Write Retry Count (WRC)                : 16, 16, 16

Disconnect-Reconnect                    : Page [02h] (Factory, Current, Saved)
 Buffer full ratio (BFR)                : 16, 16, 16
 Buffer empty ratio (BER)               : 16, 16, 16
 Bus inactivity limit (BIL)             : 0, 0, 0 {R/O}
 Disconnect time limit (DTL)            : 0, 0, 0 {R/O}
 Connect time limit (CTL)               : 0, 0, 0 {R/O}
 Maximum burst size (MBS)               : 0, 0, 0
 Enable modify data pointers (EMDP)     : 0, 0, 0 {R/O}
 Fair arbitration (FA)                  : 0, 0, 0 {R/O}
 Disconnect immediate (DImm)            : 0, 0, 0 {R/O}
 Data transfer disconnect control (DTDC) : 0, 0, 0 {R/O}
 First burst size (FBS)                 : 0, 0, 0 {R/O}

Data Compression                        : Page [0Fh] (Factory, Current, Saved)
 DCE                                    : 1, 0, 1
 DCC                                    : 1, 1, 1 {R/O}
 DDE                                    : 1, 1, 1
 RED                                    : 0, 0, 0
 Compression algorithm                  : 00000003h, 00000003h, 00000003h
 Decompression algorithm                : 00000000h, 00000003h, 00000000h

Tape Control                            : Page [10h] (Factory, Current, Saved)
 Change active partition (CAP)          : 0, 0, 0
 Change active format (CAF)             : 0, 0, 0 {R/O}
 Active format                          : 0, 0, 0 {R/O}
 Active partition                       : 0, 0, 0
 Write buffer full ratio                : 0, 0, 0 {R/O}
 Read buffer empty ratio                : 0, 0, 0 {R/O}
```

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```
Write delay time (in 100ms)             : 0, 0, 0
Data buffer recovery (DBR)              : 0, 0, 0 {R/O}
Block identifiers supported (BIS)       : 1, 1, 1 {R/O}
Report setmarks (RSMK)                  : 1, 1, 1 {R/O}
Automatic velocity control (AVC)        : 0, 1, 1
Stop on consecutive filemarks (SOCF)    : 0, 0, 0 {R/O}
Recover buffer over (RBO)               : 0, 0, 0 {R/O}
Recover error warning (REW)             : 0, 0, 0 {R/O}
Gap size                                : 0, 0, 0 {R/O}
EOD Defined                             : 0, 0, 0 {R/O}
Enable EOD generation (EEG)             : 1, 1, 1 {R/O}
Synchronize early warning (SEW)         : 1, 1, 1 {R/O}
Soft write protect (SWP)                : 0, 0, 0 {R/O}
Buffer size at early warning            : 000000h, 000000h, 000000h
Data compression algorithm              : 00h, 00h, 00h
Associated write protect (ASOCWP)       : 0, 0, 0 {R/O}
Persistent write protect (PERSWP)       : 0, 0, 0 {R/O}
Permanent write protect (PRMWP)         : 0, 0, 0 {R/O}
```

Is tape drive starting/stopping too often or slow?

Look at the disconnect-reconnect settings and some of the highlighted fields above. Both your tape backup software vendor and hardware vendor should have good information on what settings are "best". The built in mode-page editor 144 can be used to set these to optimal values. Often you just need to modify something like a buffer empty or buffer full ratio 145 setting.

Is performance suffering due to media problems and/or errors?

Below comes from the log page inquiry. (By the way, you can monitor these values real-time during a backup via threshold monitoring 158. Any error, whether corrected or uncorrected will require everything to stop for retries and data correction attempts.

Note that our software does not keep track of how many times a tape has been used, or cleaned, or if the heads are dirty. Most tape drives have this built-in capability, and our software provides this information to you.

```
Number of minutes of motion since last head cleaning: 94
Number of head cleanings: 5
Number of lost servo locks on writes: 0
Number of write servo dropouts: 0
Number of lost servo locks on reads: 0
Number of read servo dropouts: 0
Cartridge serial number: 496256
Number of times this cartridge loaded: 18
Number of beginning-of-tape markers passed for this tape: 253
Number of end-of-tape markers passed for this tape: 14
Number of cartridge write past counters: 27
Number of minutes cartridge has been in motion: 121
Buffer under-runs: 22
Buffer over-runs: 1
Write errors corrected with possible delays: 155808
Total Write errors: 345
Write errors corrected: 345
Times correction algorithm processed (on Writes): 0
Bytes processed (on Writes): 295436288
Unrecovered errors (on Writes): 0
Read errors corrected with possible delays: 0
Total Read errors: 1
Read errors corrected: 1
Times correction algorithm processed (on Reads): 1
Bytes processed (on Reads): 7602176
Unrecovered errors (on Reads): 0
```

1.42 TapeAlert Testing

This function can only be used on tape drives and autochangers which support the TapeAlert test feature. (Please refer to the Tape Drive Testing and Optimization 144 section for additional information not covered in this topic)
You would use this command to program a false (test) error, so you can see what would happen if you had a real tape error. When invoked, the command performs the following functions. (For brevity, we will assume the unit has this

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capability and no problems are found issuing the appropriate commands.

- Performs a mode select to temporarily to set the TapeAlert test bit. This will cause TapeAlert polls to return sense information indicating a false TapeAlert Error.
- Polls the device. It will return sense information 5D FF, which will be reported as "TapeAlert FALSE (test) predictive failure alert."
- The mode page will be restored in order to disable TapeAlert testing.

Syntax
`-XT {devicefile}`.

Frequently Asked Question:
Q.How do I safely generate a TapeAlert error that does not require breaking something.
A.Most devices that have TapeAlert capability set off an alert if you load invalid media into the device. For example, we have some DDS4 media which is not supported in one of our HP C1533A tape drives. In order to generate an error, we stick the DDS4 media in the device and the HP will reject it shortly after the cartridge is tensioned. Then we poll it. The resulting message will have, " Unsupported Format - You have loaded a cartridge of a type not recognized by this tape drive.",

Q. What will be returned if the device does not support this feature?
A. The program will report: "Tape Alert test failed -- Device does not support this feature. No changes were made."

Q. What if I have more than one TapeAlert condition?
A. The program will report all status text. It will look at whether each message is critical, an error, or a warning and use the worst-case state to classify the warning for the system's event log.

Q. What message strings are returned?
A. The strings below are defined by the software. Not all tape/changer devices have the capability to report all of these messages.

- **Read Warning - The tape drive is having problems reading data. (No data lost, but reduction in performance.)**
- **Write Warning - The tape drive is having problems writing data. (No data lost, but reduction in performance.)**
- **Hard Error - The operation has stopped because the drive could not recover from the error condition.**
- **Media Error - Your data is at risk. Do not use this tape media again.**
- **Read Error - The tape is damaged or the drive is faulty.**
- **Write Error - The tape is from a faulty batch or the tape drive is faulty.**
- **Media Life - The tape cartridge has reached the end of its calculated useful life.**
- **Not Data Grade - The cartridge is not data grade. Data written to it will be at risk.**
- **Write Protect - You are trying to write to a write-protected cartridge.**
- **No Removal - You can not remove this cartridge while it is in use.**
- **Cleaning Media - The tape in the drive is a cleaning cartridge.**
- **Unsupported Format - You have loaded a cartridge of a type not recognized by this tape drive.**
- **Recoverable Snapped Tape - The operation has failed because the tape in the drive has snapped.**
- **Unrecoverable Snapped Tape - The operation has failed because the tape in the drive has snapped.**
- **Memory Chip Failure - The memory chip in the cartridge has failed, which will affect performance only.**
- **Forced Eject - The operation has failed because the cartridge was manually ejected during I/O.**
- **Read-Only Format - You have loaded a cartridge of type which is read only.**
- **Tape Directory Corrupted - The directory is corrupted. File search will be degraded.**
- **Nearing Media Life - The cartridge is nearing the end of its calculated life.**
- **Clean Now - The tape drive needs cleaning.**
- **Clean Periodic - The tape drive needs routine cleaning.**
- **Expired Cleaning Media - The last cleaning cartridge used needs to be replaced.**
- **Invalid Cleaning Media - The last cleaning cartridge used was an invalid type.**
- **Retention Requested - The tape drive has requested a retension operation.**
- **Dual-Ported Interface Error - A redundant interface port has failed.**
- **Cooling Fan Failure - A cooling fan has failed.**
- **Power Supply Failure - A redundant power supply has failed.**
- **Power Consumption - The tape drive power consumption is outside the specified range.**

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- Drive Maintenance - Preventive maintenance on the drive is required.
- Hardware Fault A - The tape drive has vendor-defined hardware fault (requires reset to recover).
- Hardware Fault B - The tape drive has vendor-defined hardware fault (requires power cycle to recover).
- Interface - The tape drive has a problem with the application client interface.
- Eject Media - The operation has failed (eject, reinsert, restart application).
- Download Fail - The last firmware download failed.
- Drive Humidity - Environmental conditions inside the tape drive are outside the specified range.
- Drive Temperature - Environmental conditions inside the tape drive are outside the specified range.
- Drive Voltage - Power conditions are outside the specified range.
- Predictive Failure - A hardware failure of the tape drive is predicted.
- Diagnostics Required - The tape drive may have a hardware fault. Run diagnostics.
- Loader Hardware A - The changer mechanism is having difficulty communicating with the tape drive.
- Loader Stray Tape - A tape has been left in the autoloader by a previous hardware fault.
- Loader Hardware B - The loader mechanism has a hardware fault.
- Loader Door - The operation has failed because the autoloader door is open.
- Loader Hardware C - The autoloader has a hardware fault that is not mechanically related.
- Loader Magazine - The autoloader cannot operate without the magazine.
- Loader Predictive Failure - A hardware failure of the changer mechanism is predicted.
- Lost Statistics - Media statistics have been lost at some time in the past.
- Tape Directory Invalid at Unload - The tape directory on the tape cartridge just unloaded has been corrupted.
- Tape System - The tape just unloaded could not write its system area successfully.
- Tape System Read Failure - The tape system area could not be read successfully at load time.
- No Start of Data - The start of data could not be found on the tape.
- Loading Failure - The operation has failed because the media cannot be loaded and threaded.

1.43 TapeAlert Viewer

TapeAlert refers to the capability of a tape device to provide detailed diagnostic information using the ANSI standard interface, conveniently called TapeAlert. Many modern SCSI and Fibre Channel tape drives support this feature. In general, the more expensive and robust a tape or auto changer is, the higher the probability it will have this feature.

Although the ANSI specification defines 64 flags, (click here to see it 150) several of them are reserved for future use. In addition, not all flags are used by all tape devices. See the table below for details. SMARTMon-UX reports all of the flags. In order to poll tape devices automatically, invoke the program with the -X option and be sure to pass it the physical device names for your tape devices. If the tape does not support TapeAlert, the program will tell you and move on.

If you wish to view the TapeAlert-related capabilities of your tape or auto changer, invoke the program with the -X+ option. This will cause it to report all supported and unsupported TapeAlert features.

```
smartmon-ux -X+
SMARTMon-ux [Release 1.12, Build 18-AUG-2002] - Copyright 2002 SANtools, Inc. http://www.SANtools.com
Discovered TANDBERG SLR7 S/N "SN007005396" on \\.\TAPE0 (tape - TapeAlert enabled) [Adapter/ID.LUN=3/3.0]
 TapeAlert status and capabilities dump below:
  Read Warning                    : Unsupported
  Write Warning                   : Passed
  Hard Error                      : Passed
  Media Error                     : Passed
  Read Error                      : Passed
  Write Error                     : Unsupported
  End of Media Life               : Unsupported
  Not Data Grade                  : Unsupported
  Write Protect                   : Unsupported
  No Removal                      : Unsupported
  Cleaning Media                  : Unsupported
  Unsupported Format              : Unsupported
  Recoverable Snapped Tape        : Unsupported
  Unrecoverable Snapped Tape      : Unsupported
  Memory Chip Failure             : Unsupported
  Forced Eject                    : Unsupported
  Read-Only Format                : Unsupported
  Tape Directory Corrupted        : Unsupported
```

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```
  Nearing Media Life               : Passed
  Clean Now                        : Unsupported
  Clean Periodic                   : Passed
  Expired Cleaning Media           : Unsupported
  Invalid Cleaning Media           : Unsupported
  Retention Requested              : Unsupported
  Dual-Ported Interface Error      : Unsupported
  Cooling Fan Failure              : Unsupported
  Power Supply Failure             : Unsupported
  Power Consumption                : Unsupported
  Drive Maintenance                : Unsupported
  Hardware Fault A                 : Passed
  Hardware Fault B                 : Unsupported
  Interface                        : Unsupported
  Eject Media                      : Unsupported
  Download Fail                    : Unsupported
  Drive Humidity                   : Unsupported
  Drive Temperature                : Unsupported
  Drive Voltage                    : Unsupported
  Predictive Failure               : Unsupported
  Diagnostics Required             : Unsupported
  Loader Hardware A                : Unsupported
  Loader Stray Tape                : Unsupported
  Loader Hardware B                : Unsupported
  Loader Door                      : Unsupported
  Loader Hardware C                : Unsupported
  Loader Magazine                  : Unsupported
  Loader Predictive Failure        : Unsupported
  Lost Statistics                  : Unsupported
  Tape Directory Invalid at Unload : Unsupported
  Tape System                      : Unsupported
  Tape System Read Failure         : Unsupported
  No Start of Data                 : Unsupported
  Loading Failure                  : Unsupported
Discovered HP C1533A S/N " " on \\.\TAPE1 (tape - TapeAlert enabled) [Adapter/ID.LUN=3/6.0]
 TapeAlert status and capabilities dump below:
  Read Warning                     : ReportableInFailureOnly
  Write Warning                    : ReportableInFailureOnly
  Hard Error                       : ReportableInFailureOnly
  Media Error                      : ReportableInFailureOnly
  Read Error                       : ReportableInFailureOnly
  Write Error                      : ReportableInFailureOnly
  End of Media Life                : ReportableInFailureOnly
  Not Data Grade                   : ReportableInFailureOnly
  Write Protect                    : ReportableInFailureOnly
  No Removal                       : ReportableInFailureOnly
  Cleaning Media                   : ReportableInFailureOnly
  Unsupported Format               : ReportableInFailureOnly
  Recoverable Snapped Tape         : ReportableInFailureOnly
  Unrecoverable Snapped Tape       : ReportableInFailureOnly
  Memory Chip Failure              : ReportableInFailureOnly
  Forced Eject                     : ReportableInFailureOnly
  Read-Only Format                 : ReportableInFailureOnly
  Tape Directory Corrupted         : ReportableInFailureOnly
  Nearing Media Life               : ReportableInFailureOnly
  Clean Now                        : ReportableInFailureOnly
  Clean Periodic                   : ReportableInFailureOnly
  Expired Cleaning Media           : ReportableInFailureOnly
  Invalid Cleaning Media           : ReportableInFailureOnly
  Retention Requested              : ReportableInFailureOnly
  Dual-Ported Interface Error      : ReportableInFailureOnly
  Cooling Fan Failure              : ReportableInFailureOnly
  Power Supply Failure             : ReportableInFailureOnly
  Power Consumption                : ReportableInFailureOnly
  Drive Maintenance                : ReportableInFailureOnly
  Hardware Fault A                 : ReportableInFailureOnly
  Hardware Fault B                 : ReportableInFailureOnly
  Interface                        : ReportableInFailureOnly
  Eject Media                      : ReportableInFailureOnly
  Download Fail                    : ReportableInFailureOnly
  Drive Humidity                   : ReportableInFailureOnly
```

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```
  Drive Temperature               : ReportableInFailureOnly
  Drive Voltage                   : ReportableInFailureOnly
  Predictive Failure              : ReportableInFailureOnly
  Diagnostics Required            : ReportableInFailureOnly
  Loader Hardware A               : ReportableInFailureOnly
  Loader Stray Tape               : ReportableInFailureOnly
  Loader Hardware B               : ReportableInFailureOnly
  Loader Door                     : ReportableInFailureOnly
  Loader Hardware C               : ReportableInFailureOnly
  Loader Magazine                 : ReportableInFailureOnly
  Loader Predictive Failure       : ReportableInFailureOnly
  Lost Statistics                 : ReportableInFailureOnly
  Tape Directory Invalid at Unload : ReportableInFailureOnly
  Tape System                     : ReportableInFailureOnly
  Tape System Read Failure        : ReportableInFailureOnly
  No Start of Data                : ReportableInFailureOnly
  Loading Failure                 : ReportableInFailureOnly
Terminating program.
```

In the situation above, there are two tape drives attached. The Tandberg drive has full TapeAlert capability and including the ability to report to a calling program programmatically which features it supports. The HP drive also supports TapeAlert, but it is not smart enough to let a program know exactly what features it supports.

Be sure to refer to the **ANSI specification** 150 images to know exactly what each message means and whether they are informational, warnings, or critical messages.

If you invoke SMARTMON-UX with the **-X option**, it will poll tapes at the specified polling periods and produce a message such as:

```
\\.\TAPE0 polled at Sun Aug 18 23:19:21 2002 Status:Passed
```

If there was a problem, you might see:

```
\\.\TAPE0 polled at Sun Aug 18 23:26:49 2002 Status:Not Data Grade - The
cartridge is not data grade. Data written to it will be at risk.
```

Note that it is possible that in the event of a TapeAlert, you will get more than one message per polling cycle.

1.44 TapeAlert ANSI Descriptions

The pages below are from the ANSI manual which describe all of the TapeAlerts in detail. In the event SMARTMON informs you that you have a TapeAlert 148 condition, please contact your tape supplier to determine what corrective action may be required.

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Annex A
(normative)

A.1 TapeAlert log page parameter codes (flags)

Keywords for table A.1 are defined as follows:
Type: O = optional
M = mandatory
Flag type:
C = critical
W = warning
I = informational

Table A.1 — TapeAlert log page parameter codes

Code	Flag	Type	Flag type	Recommended application client message	Probable cause
01h	Read warning	O	W	The tape drive is having problems reading data. No data has been lost, but there has been a reduction in the performance of the tape.	The drive is having severe trouble reading.
02h	Write warning	O	W	The tape drive is having problems writing data. No data has been lost, but there has been a reduction in the capacity of the tape.	The drive is having severe trouble writing.
03h	Hard error	M	W	The operation has stopped because an error has occurred while reading or writing data which the drive cannot correct.	The drive had a hard read or write error.
04h	Media	M	C	Your data is at risk: 1. Copy any data you require from this tape. 2. Do not use this tape again. 3. Restart the operation with a different tape.	Media can no longer be written/read, or performance is severely degraded.
05h	Read failure	M	C	The tape is damaged or the drive is faulty. Call the tape drive supplier help line.	The drive can no longer read data from the tape.
06h	Write failure	M	C	The tape is from a faulty batch or the tape drive is faulty: 1. Use a good tape to test the drive. 2. If the problem persists, call the tape drive supplier help line.	The drive can no longer write data to the tape.
07h	Media life	O	W	The tape cartridge has reached the end of its calculated useful life: 1. Copy any data you need to another tape. 2. Discard the old tape.	The media has exceeded its specified life.
08h	Not data grade	O	W	The cartridge is not data-grade. Any data you write to the tape is at risk. Replace the cartridge with a data-grade tape.	The drive has not been able to read the MRS[a] stripes.
09h	Write protect	O	C	You are trying to write to a write protected cartridge. Remove the write protection or use another tape.	Write command is attempted to a write protected tape.

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Table A.1 — TapeAlert log page parameter codes

Code	Flag	Type	Flag type	Recommended application client message	Probable cause
0Ah	No removal	O	I	You cannot eject the cartridge because the tape drive is in use. Wait until the operation is complete before ejecting the cartridge.	Manual or software unload attempted when prevent media removal is on.
0Bh	Cleaning media	O	I	The tape in the drive is a cleaning cartridge.	Cleaning tape loaded into drive.
0Ch	Unsupported format	O	I	You have tried to load a cartridge of a type that is not supported by this drive.	Attempted load of unsupported tape format (e.g., DDS2 in DDS1 drive).
0Dh	Recoverable snapped tape	O	C	The operation has failed because the tape in the drive has snapped: 1. Discard the old tape. 2. Restart the operation with a different tape.	Tape snapped/cut in the drive where media can be ejected.
0Eh	Unrecoverable snapped tape	O	C	The operation has failed because the tape in the drive has snapped: 1. Do not attempt to extract the tape cartridge. 2. Call the tape drive supplier help line.	Tape snapped/cut in the drive where media cannot be ejected.
0Fh	Memory chip in cartridge failure	O	W	The memory in the tape cartridge has failed, which reduces performance. Do not use the cartridge for further write operations.	Memory chip failed in cartridge.
10h	Forced eject	O	C	The operation has failed because the tape cartridge was manually ejected while the tape drive was actively writing or reading.	Manual or forced eject while drive actively writing or reading.
11h	Read only format	O	W	You have loaded a cartridge of a type that is read-only in this drive. The cartridge will appear as write protected.	Media loaded that is read-only format.
12h	Tape directory corrupted on load	O	W	The tape directory on the tape cartridge has been corrupted. File search performance will be degraded. The tape directory can be rebuilt by reading all the data on the cartridge.	Tape drive powered down with tape loaded, or permanent error prevented the tape directory being updated.
13h	Nearing media life	O	I	The tape cartridge is nearing the end of its calculated life. It is recommended that you: 1. Use another tape cartridge for your next backup. 2. Store this tape cartridge in a safe place in case you need to restore data from it.	Media may have exceeded its specified number of passes.

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Table A.1 — TapeAlert log page parameter codes

Code	Flag	Type	Flag type	Recommended application client message	Probable cause
14h	Clean now	M	C	The tape drive needs cleaning: 1. If the operation has stopped, eject the tape and clean the drive. 2. If the operation has not stopped, wait for it to finish and then clean the drive. Check the tape drive users manual for device specific cleaning instructions.	The drive thinks it has a head clog or needs cleaning.
15h	Clean periodic	O	W	The tape drive is due for routine cleaning: 1. Wait for the current operation to finish. 2. Then use a cleaning cartridge. Check the tape drive users manual for device specific cleaning instructions.	The drive is ready for a periodic cleaning.
16h	Expired clean-ing media	M	C	The last cleaning cartridge used in the tape drive has worn out: 1. Discard the worn out cleaning cartridge. 2. Wait for the current operation to finish. 3. Then use a new cleaning cartridge.	The cleaning tape has expired.
17h	Invalid clean-ing tape	O	C	The last cleaning cartridge used in the tape drive was an invalid type: 1. Do not use this cleaning cartridge in this drive. 2. Wait for the current operation to finish. 3. Then use a valid cleaning cartridge.	Invalid cleaning tape type used.
18h	Reten-sion requeste d	O	W	The tape drive has requested a retension operation.	The drive is having severe trouble read-ing or writing, which will be resolved by a retension cycle.
19h	Dual-por t inter-face error	O	W	A redundant interface port on the tape drive has failed.	Failure of one inter-face port in a dual-port configura-tion (i.e., Fibre Chan-nel)
1Ah	Cooling fan fail-ure	O	W	A tape drive cooling fan has failed.	Fan failure inside tape drive mecha-nism or tape drive enclosure.
1Bh	Power supply failure	O	W	A redundant power supply has failed inside the tape drive enclosure. Check the enclosure users manual for instructions on replacing the failed power supply.	Redundant PSU fail-ure inside the tape drive enclosure or rack subsystem.
1Ch	Power con-sump-tion	O	W	The tape drive power consumption is outside the specified range.	Power consumption of the tape drive is outside specified range.

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Table A.1 — TapeAlert log page parameter codes

Code	Flag	Type	Flag type	Recommended application client message	Probable cause
1Dh	Drive maintenance	O	W	Preventive maintenance of the tape drive is required. Check the tape drive users manual for device specific preventive maintenance tasks or call the tape drive supplier help line.	The drive requires preventive maintenance (not cleaning).
1Eh	Hardware A	O	C	The tape drive has a hardware fault: 1. Eject the tape or magazine. 2. Reset the drive. 3. Restart the operation.	The drive has a hardware fault that requires reset to recover.
1Fh	Hardware B	M	C	The tape drive has a hardware fault: 1. Turn the tape drive off and then on again. 2. Restart the operation. 3. If the problem persists, call the tape drive supplier help line.	The drive has a hardware fault which is not read/write related or requires a power cycle to recover.
20h	Interface	O	W	The tape drive has a problem with the application client interface: 1. Check the cables and cable connections. 2. Restart the operation.	The drive has identified an interface fault.
21h	Eject media	O	C	The operation has failed: 1. Eject the tape or magazine. 2. Insert the tape or magazine again. 3. Restart the operation.	Error recovery action.
22h	Download fail	O	W	The firmware download has failed because you have tried to use the incorrect firmware for this tape drive. Obtain the correct firmware and try again.	Firmware download failed.
23h	Drive humidity	O	W	Environmental conditions inside the tape drive are outside the specified temperature range.	Drive humidity limits exceeded.
24h	Drive temperature	O	W	Environmental conditions inside the tape drive are outside the specified temperature range.	Drive temperature limits exceeded.
25h	Drive voltage	O	W	The voltage supply to the tape drive is outside the specified range.	Drive voltage limits exceeded.
26h	Predictive failure	O	C	A hardware failure of the tape drive is predicted. Call the tape drive supplier help line.	Predictive failure of drive hardware.
27h	Diagnostics required	O	W	The tape drive may have a hardware fault. Run extended diagnostics to verify and diagnose the problem. Check the tape drive users manual for device specific instructions on running extended diagnostic tests.	The drive may have a hardware fault which may be identified by extended diagnostics (i.e., SEND DIAGNOSTIC command).

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Table A.1 — TapeAlert log page parameter codes

Code	Flag	Type	Flag type	Recommended application client message	Probable cause
28h	Loader hardware A	O	C	The changer mechanism is having difficulty communicating with the tape drive: 1. Turn the autoloader off then on. 2. Restart the operation. 3. If a problem persists, call the tape drive supplier help line.	Loader mechanism is having trouble communicating with the tape drive.
29h	Loader stray tape	O	C	A tape has been left in the autoloader by a previous hardware fault: 1. Insert an empty magazine to clear the fault. 2. If the fault does not clear, turn the autoloader off and then on again. 3. If the problem persists, call the tape drive supplier help line.	Stray tape left in loader after previous error recovery.
2Ah	Loader hardware B	O	W	There is a problem with the autoloader mechanism.	Loader mechanism has a hardware fault.
2Bh	Loader door	O	C	The operation has failed because the autoloader door is open: 1. Clear any obstructions from the autoloader door. 2. Eject the magazine and then insert it again. 3. If the fault does not clear, turn the autoloader off and then on again. 4. If the problem persists, call the tape drive supplier help line.	Tape changer door open.
2Ch	Loader hardware C	O	C	The autoloader has a hardware fault: 1. Turn the autoloader off and then on again. 2. Restart the operation. 3. If the problem persists, call the tape drive supplier help line. Check the autoloader users manual for device specific instructions on turning the device power on and off.	The loader mechanism has a hardware fault that is not mechanically related.
2Dh	Loader magazine	O	C	The autoloader cannot operate without the magazine: 1. Insert the magazine into the autoloader. 2. Restart the operation.	Loader magazine not present.
2Eh	Loader predictive failure	O	W	A hardware failure of the changer mechanism is predicted. Call the tape drive supplier help line.	Predictive failure of loader mechanism hardware.
32h	Lost statistics	O	W	Media statistics have been lost at some time in the past.	Drive or library powered don with tape loaded.

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Table A.1 — TapeAlert log page parameter codes

Code	Flag	Type	Flag type	Recommended application client message	Probable cause
33h	Tape directory invalid at unload	O	W	The tape directory on the tape cartridge just unloaded has been corrupted. File search performance will be degraded. The tape directory can be rebuilt by reading all the data.	Error preventing the tape directory being updated on unload.
34h	Tape system	O	C	The tape just unloaded could not write its system area successfully: 1. Copy data to another tape cartridge. 2. Discard the old cartridge.	Write errors while writing the system log on unload.
35h	Tape system area read failure	O	C	The tape system area could not be read successfully at load time: 1. Copy data to another tape cartridge.	Read errors while reading the system area on load.
36h	No start of data	O	C	The start of data could not be found on the tape: 1. Check that you are using the correct format tape. 2. Discard the tape or return the tape to your supplier.	Tape damaged, bulk erased, or incorrect format.
37h	Loading failure	O	C	The operation has failed because the media cannot be loaded and threaded. 1. Remove the cartridge, inspect it as specified in the product manual, and retry the operation. 2. If the problem persists, call the tape drive supplier help line.	The drive is unable to load the media and thread the tape.
a. Media Recognition System (MRS) is a method where pre-defined stripes are placed at the beginning of the media to identify the media. The MRS stripes are read to determine if the media is of data-grade. Data-grade media should be used in SCSI streaming devices since it is of the required quality and consistency to be used to store data (i.e., audio/video grade media should not be used).					

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1.45 Thermal Warning

This feature can be added to the command-line and run in the background as part of the scheduled polling process.

When you invoke smartmon-ux with the optional **`-G threshold_temperature`** warning, you instruct the software to not only monitor SMART alerts, but to also report alerts if the disk temperature meets or exceeds the supplied temperature.

This feature requires that you have a SCSI, Fibre Channel, or SSA disk that reports temperature via the ANSI-defined temperature log page entry (found on page 2Fh). If you are not sure whether or not your disk reports temperature here, you can just try the command and give it a threshold of 1 degree C. If your device supports temperature reporting, you will get the alert in the syntax reported below.

Temperature polling does not have any significant additional load and is a convenient fail-safe to insure your computer does not run too hot.

Note that you can also monitor temperature via sophisticated scripts, even if drive temperature is not reported on page 2F (hex), but is reported in a vendor-unique page that smartmon is already aware of. Use the threshold configuration 158 and threshold monitoring 158 features to create temperature over time log files or warnings if temperature increases 5 degrees or more over a few minutes.

```
[root@rh90 smartmon]# ./smartmon-ux -F 600  -G 40-L  /dev/sda
SMARTMon-ux [Release 1.21, Build 26-JUL-2003] - Copyright 2003 SANtools, Inc. http://www.SANtools.com
Discovered SEAGATE ST373307LC S/N "3HZ0381E" on /dev/sda (Enabling SMART)(70007 MB)

Launching job #27401 in background - Will poll every 600 seconds.
```

This instructs the software to check temperature and report a thermal warning if temperature exceeds 40 degrees C. (Temperature is always monitored and reported in degrees C, not degrees F).

The **`-L`** option instructs the software to log results in the file **`smartmon-ux.txt`**. In the case of LINUX, the file is saved in the **`/var/log`** directory.

Below is the tail end of the log file. Since the disk was at 42 degrees when the program was launched, the text highlighted in **red** will be added to the log file.

Sun Jul 20 20:24:03 2003: ./smartmon-ux started
Sun Jul 20 20:24:04 2003: Discovered SEAGATE ST373307LC S/N "3HZ0381E" on /dev/sda (Enabling SMART)(70007 MB)
Sun Jul 20 20:24:04 2003: /dev/sda polled at Sun Jul 27 20:24:04 2003 Status:Passed (Temperature = 43C 109F)
Sun Jul 20 20:24:04 2003: Device on /dev/sda, Thermal alert. Temperature now at 43C 55F degrees.

Once a thermal alert is sent out, they are not repeated every polling cycle. The temperature has to go below the threshold to reset the trigger to allow thermal alerts to be logged. If you launched the program with **`-G 45`**, the line in **red** would *not* get added to the log file.

If you always just want to report the temperature, but do not want thermal alerts, pass it some high temperature, such as **`-G 99`**. As this is over 200 degrees F, your computer and disk drive would have shut down (or melted), long before that, and you will never get an alert.

If you want to know what temperature your disk will enter a thermal alert on its own, you can either read the disk drive's specification (which is difficult to find), or ask smartmon-ux ....

```
./smartmon-ux -C /dev/sda
SMARTMon-ux [Release 1.21, Build 26-JUL-2003] - Copyright 2003 SANtools, Inc. http://www.SANtools.com
Discovered SEAGATE ST373307LC S/N "3HZ0381E" on /dev/sda (SMART enabled)(70007 MB)
 Statistical log pages dump below [# of bytes reserved for value in device]:
```

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(.. truncated here)

```
Current temperature +/- 3 degrees C: 41
Reference temperature +/- 3 degrees C: 68
```

The current temperature is 41C, and the shutdown is 68C. You can see that this disk drive can run much hotter before there is need for concern.

Notes:
The temperature for SCSI, SAS, and fibre channel devices is standardized, but optional.
You can also obtain device temperature via the log page viewer 65.

1.46 Threshold Monitoring

In order to monitor thresholds, invoke your user-defined scripts, and email alerts and log file entries, you must invoke the program with the **-W** 158 option and supply SMARTMon-UX with the name of your configuration file.

Usage
smartmon-ux -Wfilename

Example
smartmon-ux -WDiskRWActivityRecorder.cfg

For details on the syntax and creation of the script, refer to the Threshold Configuration 158 portion of this manual.

Note: Do not put a space between the -W and the filename!

1.47 Threshold Configuration

Threshold monitoring, introduced in release 1.15, is a powerful method for defining exactly what you want to monitor, how often you want to look at it, and what you want to happen should it occur.

What can you do with log page threshold monitoring?
- Provide an alert if you have an A/C failure by monitoring drive temperature.
- Watch for unrecovered read or write errors.
- Watch for unrecovered write errors which might indicate data corruption.
- Automatically alert you when your tape drive indicates it needs to have the heads cleaned.
- Tell you if you have unrecovered read or write errors from your tape drive when creating a backup or performing a recovery.
- Interface storage device and status information for your JBOD into enterprise-level SRM packages.

By optionally configuring an event script, you can launch a procedure of your choice if you have such a situation. For example, with relatively little effort, you could poll megabytes read of a disk on 5 minute intervals, append the information into a flat file, and import it into a spread sheet to graph your throughput over time. If you have a disk that is in a SAN that is shared among multiple systems, there is NO other way to determine this information.

In order to utilize this feature, you must create a configuration file and launch SMARTMon-UX with the **-W** option ***(Note - no space between the W and the filename)*** and pass it the name of the configuration file. The configuration file is managed by launching smartmon-ux in the interactive mode with the **-K** option. You then choose *configuration commands* in order to manipulate the file. This configuration file is in ASCII text, and you are free to edit it manually if you desire. Once you familiarize yourself with the record layout, you might find it much more efficient to edit it manually. Note that while the record layout is slightly different for UNIX and Windows-family operating systems, it is consistent across all UNIX and LINUX versions.

Configuration Commands
When you launch the program with the **-K** option (**smartmon-ux -K**), it discovers all peripherals and returns with a list of options. The program will not launch into the background, and it will not monitor hardware. The purpose of this

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mode is to provide a means to have the program manage a configuration file, rather than require you to edit one manually.

This section of the documentation makes frequent use of screen snapshots. All computer-generated output is shown in blue, and all entered text is shown in red.

```
# smartmon-ux -K
(device information displays here)
Command (Enter ? for help): ?
  ?: Help
  S: Select device for threshold definition
  A: Add threshold entries for selected device
  V: View all defined thresholds
  D: Delete range of threshold entries
  P: Purge ALL threshold entries (erase all defined thresholds)
  L: Load threshold entries from file
  W: Write threshold entries to file
  Q: Quit this function

Command (Enter ? for help):
```

Option S - Select Device

This displays a list of discovered devices for this machine and assigns an index number to each of them. You then select a device which will be used to add threshold entries. The selected device is applicable to adding (or modifying) threshold entries. Only choices applicable to the selected device will display. Below is the dump for a Windows-based machine. If you were attached to a UNIX machine, you would not see the adapter, channel, port, and ID information, but you would see the standard UNIX device driver name for the peripheral.

```
Command (Enter ? for help): S
Device#   Adapter  Port  Channel  ID  Description              Device Path
 *  0        4        2      3     0  SEAGATE ST1181677FC      \\.\PHYSICALDRIVE5
    1        4        2      4     0  HITACHI DK31CJ-72FC      \\.\PHYSICALDRIVE6
    2        4        2      5     0  SGI ST336704FC           \\.\PHYSICALDRIVE7
    3        4        2      6     0  IBM DNEF-309170          \\.\PHYSICALDRIVE8
    4        4        2      7     0  IBM DNEF-309170          \\.\PHYSICALDRIVE9
    5        4        2      8     0  IBM DNEF-309170          \\.\PHYSICALDRIVE10
    6        4        2      9     0  IBM DNEF-309170          \\.\PHYSICALDRIVE11
    7        4        2     10     0  IBM DNEF-309170          \\.\PHYSICALDRIVE12
    8        4        2     11     0  IBM DNEF-309170          \\.\PHYSICALDRIVE13
    9        4        2     12     0  IBM DNEF-309170          \\.\PHYSICALDRIVE14
   10        4        2     13     0  IBM DNEF-309170          \\.\PHYSICALDRIVE15
   11        4        2     14     0  IBM DNEF-309170          \\.\PHYSICALDRIVE16
   12        3        0      3     0  TANDBERG SLR7            \\.\TAPE0  <--(See example below for adding
thresholds)
   13        3        0      6     0  HP C1533A                \\.\TAPE1
   14        2        0      0     0  TOSHIBA DVD-ROM SD-C2202  \\.\CDROM0
Select Device (0) : 12
```

Note that the (*) indicates the currently selected device. By default, the first discovered device will always be selected.

Option A - Add threshold entries for selected device

This is the heart of configuring an event. SMARTMon-UX presents all known values (a combination of ANSI-standard log parameters 65 and our extensive list of vendor-unique fields that we have obtained from manufacturers of most FC and SCSI peripherals). SMARTMon-UX runs through this list, querying the selected device and presenting you with the current value as well as any defined action settings.

In the example below, we wish to monitor and report the cumulative number of minutes our Tandberg SLR7 tape drive has been powered on. (Not very useful in the real world, but a simple example to tutorial purposes). Note that we selected the Tandberg, which is device #12, above.

```
Command (Enter ? for help): A
```

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```
Total logical data blocks transferred (current value = 2):   Poll (N) :
Total physical blocks written to media (current value = 11026432):   Poll (N) :
Total physical blocks read from media (Read and Space operations only) (current value = 61440):   Poll (N) :
Approx remaining capacity of partition 0 (in KBytes) (current value = 19612408):   Poll (N) :
Approx remaining capacity of current partition (in KBytes) (current value = 19612408):   Poll (N) :
Approx maximum capacity of partition 0 (in KBytes) (current value = 19612408):   Poll (N) :
Approx maximum capacity of current partition (in KBytes) (current value = 19612408):   Poll (N) :
Number of file marks (current value = 0):   Poll (N) :
Number of set marks (current value = 0):   Poll (N) :
Number of minutes of motion since last head cleaning (current value = 58):   Poll (N) :
Number of head cleanings (current value = 2):   Poll (N) :
Total power-on minutes (current value = 75559):   Poll (N) : y
  Polling frequency in seconds (600) : 60
  Threshold (0) : 75000
  Send E-Mail if threshold met or exceeded (N) :
  Log event if threshold met or exceeded (Y) :
Optional program to launch: () : echo "Smartmon-ux event @ $$D: $$12=$$V" >> logfile$$1-$$2.$$3.log

Total number of cartridge loads (current value = 53):   Poll (N) :
Number of servo lock retries (current value = 0):   Poll (N) :
Number of servo track seeks (current value = 0):   Poll (N) :
Number of lost servo locks on writes (current value = 0):   Poll (N) :
Number of write servo dropouts (current value = 0):   Poll (N) :
Number of lost servo locks on reads (current value = 0):   Poll (N) :
Number of read servo dropouts (current value = 0):   Poll (N) :
Current selected track number (current value = 0):   Poll (N) :
Buffer under-runs (current value = 0):   Poll (N) :
Buffer over-runs (current value = 0):   Poll (N) :
Write errors corrected with possible delays (current value = 8471):   Poll (N) :
Total Write errors (current value = 0):   Poll (N) :
Write errors corrected (current value = 0):   Poll (N) :
Times correction algorithm processed (on Writes) (current value = 0):   Poll (N) :
Bytes processed (on Writes) (current value = 0):   Poll (N) :
Unrecovered errors (on Writes) (current value = 0):   Poll (N) :
Read errors corrected with possible delays (current value = 0):   Poll (N) :
Total Read errors (current value = 0):   Poll (N) :
Read errors corrected (current value = 0):   Poll (N) :
Times correction algorithm processed (on Reads) (current value = 0):   Poll (N) :
Bytes processed (on Reads) (current value = 0):   Poll (N) :
Unrecovered errors (on Reads) (current value = 0):   Poll (N) :
Total bytes written to media (not including ECC & formatting overhead) (current value = 0):   Poll (N) :
Total bytes read from media (not including ECC & formatting overhead) (current value = 0):   Poll (N) :
Total bytes transferred to the initiator(s) (during write operations) (current value = 0):   Poll (N) :

Command (Enter ? for help): ?
```

Note that the values in parentheses indicate the default response. Only a carriage return is required if you wish to take the default. All parameters allow you to select a threshold. When you select Y or y, to begin monitoring a parameter, you will be asked to answer a few more questions. The threshold is the point where you wish the program to take an action. When polling, an event occurs if the measured value from the device ***meets or exceeds*** the value. This is important and by design. For example, if you wanted to create a log file that shows the number of unrecovered write errors before and after a tape backup, the threshold should be zero. Otherwise, you would only get feedback when there was a write error, when the threshold increased from zero.

If you select the option to generate an email, you must make sure you launch SMARTMon-UX with the appropriate option to enable email alerts, and the email address(es) you want the message to go to. No additional entry is required to globally enable event logging, but there is a **-L** runtime option which allows you to specify a different log file rather than the system default log file.

The optional program to launch looks confusing, but will make sense shortly. This is the means by which you can configure an external program or script to execute in the event the threshold is met. SMARTMon-UX uses field substitutions to pass parameters onto your command, so this external command has the information it requires to perform your desired task.

Configuring the Action Script Parameters

Prior to release 1.25, the action script contained 12 fields on windows-family operating systems and 10 fields on UNIX

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systems. At release 1.25, we were able to provide a common format and layout for all operating systems. In addition to the first 10 substitution fields, there are 4 fields unique to Windows ($$11 - $$14) and 8 additional fields common to all operating systems. These 8 additional parameters either provide field substitution or instruct the program to perform an action such as terminate the program.

Below is the header of system-generated configuration files which provides details on these fields.

```
#
# DO NOT MODIFY LINE BELOW
# Version 1.03 Fri Mar 12 00:26:40 2004
#
# This file is used to define what statistical data should be monitored
# and reported at each polling interval. It may be edited manually, as
# long as the record format is strictly adhered to.  Note also that there
# is one format common to all UNIX releases, and another common to Windows.
# Please refer to the manual for formatting information.
#
# Record #1:
# Field 1:  Physical Device Name (i.e, \\.\PHYSICALDRIVE3, \\.\SCSI2Port2Path0Target4Lun0 or \\.\CDROM0
#   (Both $$1 and $$P can be used to substitute for this value)
# Field 2:  Log page number (hex)
#   (Substitute as $$2)
# Field 3:  If Field #4 is P for Parameter, then this is Log page parameter#
#           Otherwise it is the hex byte offset to the start of the
#           data.
#   (Substitute as $$3)
# Field 4:  Enter 'P' if field represents the log parameter number, or
#           enter 'O' [capital letter O], if it is the byte offset
#   (Substitute as $$4)
# Field 5:  Threshold value (decimal).  If zero, then value will always get read and
#           reported (once value read is GREATER than 0). If non-zero, then a log entry
#           will be displayed and recorded only when the value read meets or exceeds the
#           threshold.
#   (Substitute as $$5)
# Field 6:  Polling frequency in seconds (decimal)
#   (Substitute as $$6 for UNIX)
# Field 7:  Can be 1 to 2 bytes. Enter 'E' to send email,
#           and/or 'L' to log threshold alert in log file. Enter 'X' for neither.
#   (Substitute as $$7)
# Field 8: Length in bytes of the data field (if Field#4 = O, otherwise, set to 0
#   (Substitute as $$8)
# Field 9: Field format string -- N (numeric), A (alphanumeric)
#   (Substitute as $$9)
# Field 10: The description. 1st character will start with a #, but that character will
#           be suppressed for reporting
#   (Substitute as $$10)
#
# Record #2:
# Script or program and options which will be launched in event threshold is exceeded
# Leave a blank line if this feature is not desired.
# WINDOWS Format:
# Both records same as above, with only exception is that fields 1-3 are replaced by the
# raw device driver. i.e.,
# \\.\PHYSICALDRIVE3 3c 11 P 1 E 0 #Time to clean the tape cartridge in Exabyte drive, rack slot #3
#
#
# Notes on substitutions
#   In addition to field substitutions, you may also use the below values:
#    $$P - Substitutes physical device path
#    $$11 - Substitutes Adapter number (same as port number, Windows only)
#    $$12 - SCSI ID of device to be queried (decimal, Windows only)
#    $$13 - SCSI LUN of device to be queried (decimal, Windows only)
#    $$14 - SCSI Path of device to be queried (decimal, Windows only) - Most but not all devices have
multiple paths
#    $$V - Substitutes the current value read that was compared against threshold
#    $$T - Substitutes event log text message that would normally be written to log
#    $$D - Substitutes date and time string in default local format for this computer
#    $$S - Substitutes time in seconds since midnight Jan 1, 1970 GMT
#    $$X$$ - Instructs SMARTMon-UX to terminate the program after invoking the script
```

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```
#    $$Y$$ - Instructs SMARTMon-UX to disable threshold monitoring for this parameter
#            after invoking the script
#    $$Z$$ - Instructs SMARTMon-UX to reset the threshold to current value + 1 after
#            invoking the script. (Think of this as turning off the alarm)
#
#    Example usage:
#       echo $$D: $$12 is currently at $$V >> EventlogDev$$1:$$2.$$3
#    will create individual event logs for specific devices on this threshold
#
```

Other rules apply:

- The action script will be interpreted literally. If you require special characters, spaces, double or single quotes, you must supply them.
- The program will not attempt to interpret the action script or check it for validity. It will merely make optional field substitutions and launch the routine. It is your responsibility to first test the script so that it has the desired effect.
- The action script utilizes the library call "system" which means the script will have all permissions, priority, and environmental variables associated with the calling routine.
- SMARTMon-UX will suspend operations until the script has been completed. If you wish to run the script in the background and have control passed back to SMARTMon-UX immediately, append an **&** to the end of the script. (This is not supported by Windows).
- There is one important characteristic of log page parameters and thresholds in general. All values use 1 to 8 bytes to store the data, and the SCSI specification does not provide a method to report an overflow or roll over. Information is reported as an unsigned integer. This means if the parameter you are interested in contains FFFFh (65535 in decimal), and it is increased by one, the value reported will be zero. That is because the maximum value that can be stored in two bytes is 65535, so it just rolls over to zero. This will normally not be a problem, because the device manufacturers and the ANSI specification typically assign a reasonable number of bytes to prevent an overflow from happening. If you enter a number that is larger than the overflow value for the threshold, SMARTMon-UX will alert you and tell you the maximum number you may use.
- You may edit this file manually, but once you go down that path, do not let SMARTMon-UX programmatically manipulate the file. Your changes may be lost.
- Lines beginning with # are treated as comments.
- SMARTMon-UX currently allows a maximum of 1024 events.
- The action script is optional, but you must still reserve a line for it. Just leave the line blank.
- Note that substitution $$11 and $$1 are valid. SMARTMon-UX looks for $$11 first, then scans for $$1. This prevents $$1 from being executed in the event that $$11 is defined.
- If you select the "A" option to add thresholds after some are already defined for the selected device, the program will default to these values as you run through them again.
- You can not define more than one set of thresholds for the same device through the programmatic means described in this section. If this is what you require, you must edit the configuration file manually. You may also just launch multiple instances of the program with different configuration files.

Option V - View all defined thresholds

This displays all defined thresholds for all devices. The devices do not have to be on-line or attached to your system. However, if they are not attached to your system, you will not be able to make any modifications to them.

```
Command (Enter ? for help): V
Pollable parameters for all devices:
Device  Driver                          Description           Threshold PollingSec Actions Description
   0    \\.\SCSI2Port2Path0Target19Lun0   SEAGATE ST1181677FC          25         60     L   Current
temperature +/- 3 degrees C
    script->"echo "Smartmon-ux event @ $$D: $$12=$$V" >> logfile$$1-$$2.$$3.log"
   1    \\.\SCSI2Port2Path0Target3Lun0    Unknown (offline)            25         60     L   Current
temperature +/- 3 degrees C
    script->"echo "Smartmon-ux event @ $$D: $$12=$$V" >> logfile$$1-$$2.$$3.log"
```

In the case above the first entry represents parameters for our Seagate disk, but the second entry is for something that is offline. Note that this example provides a means to keep individual running temperature log files for the two devices. The script works for both Windows and UNIX operating systems. Note also, if you wanted to keep a current drive temperature file that could be read by an external application, you would script something like:

```
echo $$V > CurrentTemperature_SeagateAdapter.$$1ID$$2.txt
```

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If you wanted to create a comma-delimited file for importing into a spread sheet for graphing temperature over time, then you would enter:
echo "$$S","$$V" >> TemperatureLogFile.txt

This would result in something like:
```
"23502232","30"
"23502292","30"
```
(Where first field is system time in seconds, and the second field is drive temperature). This shows the temperature remained constant for the two readings that were taken 60 seconds apart.

D - Delete range of threshold entries
This option will display all defined events and prompt you for a starting and ending sequence number to delete. Once you delete a range of entries, they will be re numbered so the remaining entries are contiguous and start at zero.

P -Purge ALL threshold entries (erase all defined thresholds)
This will delete all entries. Note that no changes will be made permanent until you save the configuration file. So if you make a mistake and want to "unpurge" entries from a selected configuration file, quit the program and start over.

L - Load threshold entries from file
You will be prompted for a configuration file. If the file does not exist, the program will tell you and nothing will happen. If the file does exist, these entries will be ADDED to the current list of entries. So, if you load a configuration file that has 5 entries for a particular device twice, you will then have 10 entries for that same device. If you save the file and invoke SMARTMon-UX with the -W option, each script will be invoked twice if the threshold condition is met.

W - Write threshold entries to file
This saves the entries into a file of your choice. By default, the file will be the name of the previously loaded configuration file. If you have not loaded a configuration file, the default will be **`smartmonux-thresholds.cfg`**, in the current directory. SMARTMon-UX will warn you if the file already exists and give you the choice whether or not to replace the file or abort the operation.

Frequently Asked Questions
1. How do I launch the action in background?
Under UNIX append the script with the "&" character. Unfortunately, Windows family operating systems do not have a method to launch command-lines in the background. That means that the action script must complete before SMARTMon-UX resumes polling devices.

2. How can I validate the parsing of an action script without launching it?
Traditionally, you would add the word echo to the beginning of the script. Add leading/trailing single quote to it and send the output to a scratch file that you can view.

3. Can I poll different devices at different polling intervals?
Yes. If you poll device "A" every 60 seconds and device "B" every 10 minutes, the threshold engine will perform the desired result properly. It will, however, have to scan all events every 60 seconds because that is the greatest common factor between the two times. Warning, if you had set device "A" to 59 seconds, but left device "B" at the 10 minute interval, the program would have to run through the list every second. That is because the greatest common factor of the two intervals is the number one. The downside is that this will cause additional CPU overhead between polling periods. (The overhead is still nominal, however). SMARTMon-UX sleeps every polling period, so millions or billions of operations could be performed between each polling interval, even if it is only one second.

4. What does the output look like?
Whatever you want it to. Look at the output below which was generated by the parameters above, described in the View All Defined Thresholds section. We wanted to see how hot drives ran after power up. The two dumps below represent a comparison between a Seagate ST1181677FC and a Hitachi DK31 ...

D:\smartmonux\smartmon-ux -Wdavid.cfg
(kill program after 15 minutes)

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```
D:\smartmonux\>type *.log

logfile4-4.0.log

"Smartmon-ux event @ Fri Oct 25 23:46:32 2002: "Current temperature +/- 3 degrees C"=37"
"Smartmon-ux event @ Fri Oct 25 23:47:36 2002: "Current temperature +/- 3 degrees C"=38"
"Smartmon-ux event @ Fri Oct 25 23:48:36 2002: "Current temperature +/- 3 degrees C"=38"
"Smartmon-ux event @ Fri Oct 25 23:49:26 2002: "Current temperature +/- 3 degrees C"=38"
"Smartmon-ux event @ Fri Oct 25 23:50:28 2002: "Current temperature +/- 3 degrees C"=38"
"Smartmon-ux event @ Fri Oct 25 23:51:29 2002: "Current temperature +/- 3 degrees C"=39"
"Smartmon-ux event @ Fri Oct 25 23:52:30 2002: "Current temperature +/- 3 degrees C"=39"
"Smartmon-ux event @ Fri Oct 25 23:53:31 2002: "Current temperature +/- 3 degrees C"=39"
"Smartmon-ux event @ Fri Oct 25 23:54:32 2002: "Current temperature +/- 3 degrees C"=39"
"Smartmon-ux event @ Fri Oct 25 23:55:33 2002: "Current temperature +/- 3 degrees C"=39"
"Smartmon-ux event @ Fri Oct 25 23:56:34 2002: "Current temperature +/- 3 degrees C"=39"
"Smartmon-ux event @ Fri Oct 25 23:57:35 2002: "Current temperature +/- 3 degrees C"=40"
"Smartmon-ux event @ Fri Oct 25 23:58:36 2002: "Current temperature +/- 3 degrees C"=40"
"Smartmon-ux event @ Fri Oct 25 23:59:37 2002: "Current temperature +/- 3 degrees C"=40"
"Smartmon-ux event @ Sat Oct 26 00:00:38 2002: "Current temperature +/- 3 degrees C"=40"

logfile4-3.0.log


"Smartmon-ux event @ Fri Oct 25 23:49:25 2002: "Current temperature +/- 3 degrees C"=28"
"Smartmon-ux event @ Fri Oct 25 23:50:28 2002: "Current temperature +/- 3 degrees C"=28"
"Smartmon-ux event @ Fri Oct 25 23:51:28 2002: "Current temperature +/- 3 degrees C"=29"
"Smartmon-ux event @ Fri Oct 25 23:52:30 2002: "Current temperature +/- 3 degrees C"=29"
"Smartmon-ux event @ Fri Oct 25 23:53:31 2002: "Current temperature +/- 3 degrees C"=29"
"Smartmon-ux event @ Fri Oct 25 23:54:32 2002: "Current temperature +/- 3 degrees C"=29"
"Smartmon-ux event @ Fri Oct 25 23:55:33 2002: "Current temperature +/- 3 degrees C"=29"
"Smartmon-ux event @ Fri Oct 25 23:56:34 2002: "Current temperature +/- 3 degrees C"=29"
"Smartmon-ux event @ Fri Oct 25 23:57:34 2002: "Current temperature +/- 3 degrees C"=29"
"Smartmon-ux event @ Fri Oct 25 23:58:36 2002: "Current temperature +/- 3 degrees C"=30"
"Smartmon-ux event @ Fri Oct 25 23:59:37 2002: "Current temperature +/- 3 degrees C"=30"
"Smartmon-ux event @ Sat Oct 26 00:00:37 2002: "Current temperature +/- 3 degrees C"=30"
"Smartmon-ux event @ Sat Oct 26 00:01:38 2002: "Current temperature +/- 3 degrees C"=30"
"Smartmon-ux event @ Sat Oct 26 00:02:40 2002: "Current temperature +/- 3 degrees C"=30"
```

Note how much hotter the Seagate drives run. If you wanted to set a thermal alert, you might want to set something like 35 degrees for the Hitachi and 45 degrees for the Seagate. You should be very concerned if the Hitachi got that hot, as it normally runs around 30 degrees C.

5. How would I configure a script to let me know if the tape heads needed cleaning or media is nearing end of life?

Luckily most tape drives and libraries support this configurable parameter. If you do not know if your tape supports this, enter **smartmon-ux -X+ <tape device name>**. You can see sample output by clicking here 148. If the output contains "Passed" for either of the two fields below, you are in luck. Your tape has the ability to talk to our software through the ANSI-standard TapeAlert specification.

```
  Nearing Media Life                : Passed
  Clean Now                         : Unsupported
```

In addition, there are typically vendor-specific fields to report this information. First, try to just run the automated procedure described in this section. Select your tape device, press "**A**" to add entries and look for a prompt indicating time to change the media. If you get one, you would probably want to log an email alert. No need for a user-defined script. If you have multiple tape drives, create a script such as DailyTapeHeadScript.cfg, set a polling interval of 24 hours, and configure your startup scripts to launch the job at system boot time.

If there is no known procedure to SMARTMon-UX, please read the next question.

6. I want to report a something that is not known to SMARTMon-UX. How do I do this?

First, contact us if this happens. We have over 1000 entries in our database and it only takes minutes to add more. We are constantly adding new ones and will be happy to provide you an update if we have one.

If we do not have an update, you should contact the manufacturer of the peripheral and ask whether or not there is a log page parameter or page that can be used to obtain this information. (Sadly, first-line technical support will be

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clueless as to what you are asking for. Request an engineer that understands programming).

If you have neither the time, desire, or resources to chase whether or not it is possible to report something, contact SANtools directly. (support@santools.com). For additional fees, we will be glad to play detective and provide you with a script to report what you desire. We have non-disclosure agreements with most peripheral manufacturers, so we can typically get the programming information required to meet your needs.

If you cannot wait, you must make a manual entry into the threshold file that describes the log page, parameter (or offset), description, and byte length. We will assume you have obtained this information from the technical support department of the device's manufacturer. Make an entry in the configuration file as documented above. Be sure to note that the log information must be entered in hex, as that is how the manufacturer documents these settings.

7. Important note - feature change in 1.23B
With the point-release 1.23B, we made an important change in how this feature works. Before this release, the threshold monitoring was combined with S.M.A.R.T. monitoring. The program would scan all devices, enable SMART polling at whatever interval you defined, and concurrently do threshold monitoring at the desired intervals.

We improved the behavior by removing this additional logic. Now if you want to monitor thresholds, that is all that will be monitored. No I/Os other than log sense I/Os (and a standard Test Unit Ready command) are sent to the device to obtain the data you desire.

8. Important note - syntax change in 1.25 (Windows only)
With the changes required to the device naming convention that were necessitated by Microsoft's new SCSI drivers, we were forced to change the syntax of the file for the Windows distribution. The syntax now matches the UNIX format. If you upgrade to version 1.25 and attempt to run a configuration file that was built with a prior release of the program, the program will detect that you are using an older-formatted file and reject the command. The quickest and easiest way to convert the file is to edit the file with your favorite text editor and replace the first three parameters (which originally contained the SCSI Channel, ID, and LUN) with the device path name as shown in the sample above 161.

1.48 Verify Data

This feature was added in release 1.41. It instructs the selected disk(s) to invoke the built-in SCSI verify function. This function is built into most disk drives and runs very quickly with near-zero host overhead. Feel free to use this on as many drives as you wish concurrently. (You must, however, run multiple instances of the software as the program will lock up until the current drive completes the process.

The **`-verify`** command is supported on SCSI, SAS, Fibre Channel disks under all operating systems. It is also supported on ATA/SATA disk drives under Windows. (If you have ATA or SATA disks on other operating systems, then check with us to see if this command is ported to your operating system.

Benefits of running SCSI Verify Function

- The **`-verify`** function runs inside of the drive firmware, so there is near-zero host overhead.
- The **`-verify`** is the fastest technique possible for the disk drive to make sure that there are no bad disk blocks. You can verify as many disks as your hosts can support concurrently.
- Blocks go bad 24x7. This command will tell you if you have any bad blocks, regardless of whether or not the block is being used by a file, before the operating system asks for the data. Once you know where you have corruption, you can react accordingly. Remember, if you have RAID5 and lose a disk drive, but have a bad block on a surviving disk, then you have 100% data loss for that chunk. Furthermore, some RAID controllers will fail a rebuild in this situation and you could very well be left with a RAID system that will not repair itself.

Syntax

`-verify -scrubv` (the -scrubq makes output verbose so bad blocks and percent complete will be reported as the drive progresses).

Example - Verifying a SCSI Drive

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```
smartmon-ux -verify -scrubv \\.\PhysicalDrive2
SMARTMon-UX [Release 1.41, Build  1-NOV-2009] - Copyright 2001-2009 SANtools(R), Inc. http://www.SANtools.com
Discovered HP 36.4G MAU3036NC S/N "KY010344" on \\.\PHYSICALDRIVE2 (Not Enabling SMART)
[Bus/Port/ID.LUN=0/2/9.0](34732 MB)

Beginning SANtools  verify fitness test for HP 36.4G MAU3036NC at \\.\PHYSICALDRIVE2 (71132960 blocks,
blocksize=512)
100%
Test completed.

Read/Verify error summary:
Verify errors for HP 36.4G MAU3036NC at \\.\PHYSICALDRIVE2: No problems found.

Program Ended.
```

Example #2 - Verifying a SATA Drive

```
smartmon-ux -verify \\.\PhysicalDrive1
SMARTMon-UX [Release 1.41, Build  1-NOV-2009] - Copyright 2001-2009 SANtools(R), Inc.
http://www.SANtools.com
Discovered Maxtor 6L100P0 S/N "L23MTW0G" on \\.\PhysicalDrive1 (SMART Enabled)
 The current device temperature is:  39C (102F) degrees

Beginning SANtools read/verify test for Maxtor 6L100P0 at \\.\PhysicalDrive1 (195813072 blocks,
blocksize=512)

Read/Verify error summary:
 Event#   PowerOnMins   HexBlockNumber   State   Reassignment Status            AdditionalInfo
      0             -           16c0f   ERR     reassign failed, data invalid   Block 93184 ERR/DEV/STAT:
                                                                                00/F0/51 Error: DRDY, DSC,
ERR
      1             -           219a7   ERR     reassign failed, data invalid   Block 137472 ERR/DEV/STAT:
                                                                                00/F0/51 Error: DRDY, DSC,
ERR
      2             -           21a19   ERR     reassign failed, data invalid   Block 137728 ERR/DEV/STAT:
                                                                                00/F0/51 Error: DRDY, DSC,
ERR

Program Ended.
```

Feature Notes:

- The SATA disk has 3 bad blocks that are unreadable, while the SCSI disk reported no errors.
- The test completed in 6 minutes on the 36GB SCSI disk, and 25 minutes on the SATA disk.
- The SCSI disk used the additional -scrubv option which reported percent complete and estimated completion time as it progressed.

1.49 Version and Version-Details

SMARTMon-UX has an internal database consisting of hundreds of vendor-unique fields specific to certain makes and models of peripherals. These are used to supplement the extensive list of ANSI-standard fields that the program queries and reports via command.

In order to determine the release number of smartmon-ux invoke the program with:

```
smartmon-ux -V
```

The response will be similar to:

```
SMARTMon-ux [Release 1.13, Build 28-NOV-2002] - Copyright 2002 SANtools, Inc.
http://www.SANtools.com
```

If you wish to view the vendor-specific fields that your release of the software is capable reporting invoke the program as:

```
[root@ia64linux smartmon]# ./smartmon-ux -V+
```

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```
SMARTMon-UX [Release 1.41, Build  1-NOV-2009] - Copyright 2001-2009 SANtools(R), Inc.
http://www.SANtools.com
 ANSI-defined reportable parameters for all (non IDE) devices:
   Write errors corrected without substantial delay
   Write errors corrected with possible delays
   Total write errors
   Write errors corrected
   Times correction algorithm processed (on writes)
   Bytes processed (on writes)
   Unrecovered errors (on writes)
   Read errors corrected with possible delays
   Read errors corrected without substantial delay
   Total read errors
   Read errors corrected
   Times correction algorithm processed (on reads)
   Bytes processed (on reads)
   Unrecovered errors (on reads)
   Read errors corrected without substantial delay
   Read errors corrected with possible delays
   Total read errors
   Read errors corrected
   Times correction algorithm processed (on reads)
   Bytes processed (on reads)
   Unrecovered errors (on reads)
   Read-reverse errors corrected without substantial delay
   Read-reverse errors corrected with possible delays
   Total read-reverse errors
   Read-reverse errors corrected
   Times correction algorithm processed (on read-reverse)
   Bytes processed (on read-reverse)
   Unrecovered errors (on read-reverse)
   Verify errors corrected without substantial delay
   Verify errors corrected with possible delays
   Total verify errors
   Verify errors corrected
   Times correction algorithm processed (on verify)
   Bytes processed (on verify)
   Unrecovered errors (on verify)
   Total non-medium errors
   Grown defects during certification
   Total blocks reallocated during format
   Total new blocks reallocated
   Power-on minutes since last format
   Bytes received from clients during WRITEs
   Number of bytes written (not counting ECC & formatting overhead)
   Number of bytes read (note counting ECC & formatting overhead)
   Number of bytes transferred to the initiators during READs
   Tape Cleaning required - 1 indicates YES
   Current temperature +/- 3 degrees C
   Reference temperature +/- 3 degrees C
   Results of last 3 self tests (details returned in text if not completed successfully)
   Device manufactured week/year
   Accounting date week/year
   Specified max start-stop cycle count
   Accumulated start-stop cycles
   Specified max load-unload cycle count
   Accumulated load-unload cycles
   Full TapeAlert information (detailed messages on failure/warning conditions)
   Buffer over-run & cause & count info (detailed message)
   Buffer under-run & cause & count info (detailed message)

 Defined Vendor-specific information for below device families: (All numeric unless otherwise marked)
   (COMPAQ) BD0366459B
     Total read/write I/Os:

   (Any) MAX3073NC
     Unknown #1:
     Unknown #2:
     Unknown #3:
     Unknown #4:
     BYTE:
```

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```
  Exabyte 110L*,Exabyte 215*,Exabyte 221L*,Exabyte 430*:
  Total number of moves:
  Total number of pick retries:
  Total number of put retries:
  Total number of scans:
  Total number of scan retries:
  Total number of scan failures:
  Total number of entry/exit port cycles:
  Total rotate retries:
  Total position to element retries:
  Total suspended reads:
  Total fatal suspended reads:
  Door closed (0=NO, 1=YES):
  Door locked (0=NO, 1=YES):
  Reach position code number:
  Cartridge seated (0=NO, 1=YES):
  Wrist front (0=NO, 1=YES):
  Wrist back (0=NO, 1=YES):
  Entry/exit port caddy present (0=NO, 1=YES):
  Entry/exit port caddy locked (0=NO, 1=YES):
  X-Axis end of tape (0=NO, 1=YES):
  X-Axis home (0=NO, 1=YES):
  Magazine 1 present (0=NO, 1=YES):
  Magazine 2 present (0=NO, 1=YES):
  Library fan fail (0=NO, 1=YES):
  Drive 1 fan fail (0=NO, 1=YES):
  Drive 2 fan fail (0=NO, 1=YES):
  Drive 3 fan fail (0=NO, 1=YES):
  Drive 4 fan fail (0=NO, 1=YES):
  Cartridge scan retries:
  Wrist axis position:
  Horizontal axis position:
  Total loads:
  Total reloads:
  Total pick retries:
  Total push retries:

(EXABYTE) EXB-8505*
  KB of data transferred to data compressor:
  KB of data transferred to tape:
  Total load count:
  Minutes since last clean:
  Cleaning count:
  Time to clean (0=NO, 1=YES):

(EXABYTE) EXB-440*,EXB-480*
  Total number of moves:
  Total number of pick retries:
  Total number of put retries:
  Total number of scans:
  Total number of scan retries:
  Total number of scan failures:
  Total number of entry/exit port cycles:
  Total rotate retries:
  Total position to element retries:
  Total suspended reads:
  Total fatal suspended reads:
  Door closed (0=NO, 1=YES):
  Door locked (0=NO, 1=YES):
  Reach position code number:
  Cartridge seated (0=NO, 1=YES):
  Wrist front (0=NO, 1=YES):
  Wrist back (0=NO, 1=YES):
  Entry/exit port caddy present (0=NO, 1=YES):
  Entry/exit port caddy locked (0=NO, 1=YES):
  X-Axis end of tape (0=NO, 1=YES):
  X-Axis home (0=NO, 1=YES):
  Magazine 1 present (0=NO, 1=YES):
  Magazine 2 present (0=NO, 1=YES):
  Library fan fail (0=NO, 1=YES):
  Drive 1 fan fail (0=NO, 1=YES):
```

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```
  Drive 2 fan fail (0=NO, 1=YES):
  Drive 3 fan fail (0=NO, 1=YES):
  Drive 4 fan fail (0=NO, 1=YES):
  Cartridge scan retries:
  Wrist axis position:
  Horizontal axis position:

(EXABYTE) EXB-8900*
  Tape ID:
  Current blocks written:
  Current blocks rewritten:
  Current blocks read:
  Current blocks ECC'd:
  Current write retries:
  Current read retries:
  Current tracking retries:
  Current data underruns:
  Current data overruns:
  Current rewinds:
  Current max temperature (C):
  Current drive serial number:
  Previous blocks written:
  Previous blocks rewritten:
  Previous blocks read:
  Previous blocks ECC'd:
  Previous write retries:
  Previous read retries:
  Previous tracking retries:
  Previous data underruns:
  Previous data overruns:
  Previous rewinds:
  Previous max temperature (C):
  Previous drive serial number:
  Lifetime blocks written:
  Lifetime blocks rewritten:
  Lifetime blocks read:
  Lifetime blocks ECC'd:
  Lifetime write retries:
  Lifetime read retries:
  Lifetime tracking retries:
  Lifetime data underruns:
  Lifetime data overruns:
  Lifetime rewinds:
  Lifetime max temperature (C):
  Lifetime load count:
  Lifetime maximum tape pass count:
  KB of data transferred to data compressor:
  KB of data transferred to tape:
  Total blocks written to drive over lifetime:
  Total blocks rewritten to drive over lifetime:
  Total blocks read from drive over lifetime:
  Total blocks ECC corrections on drive over lifetime:
  Total blocks reread from drive over lifetime:
  Total load cycles over lifetime of drive:
  # of minutes since last clean:
  # motion minutes of powered time over lifetime of drive:
  # minutes of tensioned time over lifetime of drive:
  Cleaning count:
  Time to clean tape drive (1=YES):
  Drive temperature (C):

(EXABYTE) Exabyte EZ-17*
  Total number of moves:
  Total number of pick retries:
  Total number of put retries:
  Total number of theta retries:
  Magazine present (0=NO, 1=YES):
  Cartridge ejected (0=NO, 1=YES):
  Theta home (0=NO, 1=YES):
  Cartridge seated (0=NO, 1=YES):
  Wrist front (0=NO, 1=YES):
```

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```
  Total puts:
  Total put retries:
  Total pick retries:
  Theta axis position:
  Total loads:
  Total reloads:
  Total pluck retries:
  Total short reloads:

(EXABYTE) Exabyte X80*,Exabyte X200*
  Total number of moves:
  Total number of pick retries:
  Total number of put retries:
  Total number of scans:
  Total number of scan retries:
  Total number of scan failures:
  Total number of entry/exit port cycles:
  Door closed (0=NO, 1=YES):
  Key locked (0=NO, 1=YES):
  Gripper home (0=NO, 1=YES):
  Cartridge seated (0=NO, 1=YES):
  Drum Index:
  Entry/exit port home (0=NO, 1=YES):
  Entry/exit port limit (0=NO, 1=YES):
  Power distribution fan fail (0=NO, 1=YES):
  Drive 1 fan fail (0=NO, 1=YES):
  Drive 2 fan fail (0=NO, 1=YES):
  Drive 3 fan fail (0=NO, 1=YES):
  Drive 4 fan fail (0=NO, 1=YES):
  Drive 5 fan fail (0=NO, 1=YES):
  Drive 6 fan fail (0=NO, 1=YES):
  Drive 7 fan fail (0=NO, 1=YES):
  Drive 8 fan fail (0=NO, 1=YES):
  Drive 9 fan fail (0=NO, 1=YES):
  Drive 10 fan fail (0=NO, 1=YES):
  Top power supply fail (0=NO, 1=YES):
  Bottom power supply fail (0=NO, 1=YES):
  Temperature - degrees C:
  +12V:
  -12V:
  +24V:
  +5V:
  Humidity:
  Total puts:
  Total put retries:
  Total pick retries:
  Cartridge scan retries:
  Vertical axis position:
  Reach axis position:
  Drum axis position:
  Horizontal axis position:
  Total loads:
  Total reloads:
  Total double picks:

(EXABYTE) Magnum20*
  Total number of moves:
  Total number of pick retries:
  Total number of put retries:
  Total number of scans:
  Total number of scan retries:
  Total number of scan failures:
  Total number of entry/exit port cycles:
  Total rotate retries:
  Total position to element retries:
  Door closed (0=NO, 1=YES):
  Door locked (0=NO, 1=YES):
  Gripper Home (0=NO, 1=YES):
  Cartridge seated - tape in robot (0=NO, 1=YES):
  Entry/exit port caddy present (0=NO, 1=YES):
  Entry/exit port caddy locked (0=NO, 1=YES):
```

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```
  Entry/exit port caddy unlocked (0=NO, 1=YES):
  Entry/exit port installed (0=NO, 1=YES):
  Entry/exit port home (0=NO, 1=YES):
  Entry/exit port retracted - caddy present (0=NO, 1=YES):
  Entry/exit port extended - caddy removed (0=NO, 1=YES):
  Entry/exit port door closed (0=NO, 1=YES):
  All drive bays occupied (0=NO, 1=YES):
  Upper library fan fail (0=NO, 1=YES):
  Lower library fan fail (0=NO, 1=YES):
  Power supply 1 present (0=NO, 1=YES):
  Power supply 1 good (0=NO, 1=YES):
  Power supply 2 present (0=NO, 1=YES):
  Power supply 2 good (0=NO, 1=YES):
  Power supply 3 present (0=NO, 1=YES):
  Power supply 3 good (0=NO, 1=YES):
  Power supply 4 present (0=NO, 1=YES):
  Power supply 4 good (0=NO, 1=YES):
  Total puts:
  Total put retries:
  Total pick retries:
  Total scan retries:
  Reach axis position:
  Swivel axis position:
  Vertical axis position:
  Total loads:
  Total reloads:
  Total pick retries:
  Total push retries:

(EXABYTE) Mammoth2*
  Tape ID:
  Current blocks written:
  Current blocks rewritten:
  Current blocks read:
  Current blocks ECC'd:
  Current write retries:
  Current read retries:
  Current tracking retries:
  Current data underruns:
  Current data overruns:
  Current rewinds:
  Current max temperature (C):
  Current drive serial number:
  Previous blocks written:
  Previous blocks rewritten:
  Previous blocks read:
  Previous blocks ECC'd:
  Previous write retries:
  Previous read retries:
  Previous tracking retries:
  Previous data underruns:
  Previous data overruns:
  Previous rewinds:
  Previous max temperature (C):
  Previous drive serial number:
  Lifetime blocks written:
  Lifetime blocks rewritten:
  Lifetime blocks read:
  Lifetime blocks ECC'd:
  Lifetime write retries:
  Lifetime read retries:
  Lifetime tracking retries:
  Lifetime data underruns:
  Lifetime data overruns:
  Lifetime rewinds:
  Lifetime max temperature (C):
  Lifetime load count:
  Lifetime maximum tape pass count:
  Lifetime SmartClean cycles:
  KB of data transferred to data compressor:
  KB of data transferred to tape:
```

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```
  Total blocks written to drive over lifetime:
  Total blocks rewritten to drive over lifetime:
  Total blocks read from drive over lifetime:
  Total blocks ECC corrections on drive over lifetime:
  Total blocks reread from drive over lifetime:
  Total load cycles over lifetime of drive:
  # of minutes since last clean:
  # motion minutes of powered time over lifetime of drive:
  # minutes of tensioned time over lifetime of drive:
  Cleaning count:
  Time to clean tape drive (1=YES):
  Drive temperature (C):

(EXABYTE) VXA AutoPak *
  Total number of minutes autoloader powered up over lifetime:
  Total number of power-ups over autoloader's lifetime:
  Total number of flash updates over lifetime:

(EXABYTE) VXA TAPE VXA-1*
  Cumulative number of bytes written to tape:
  Cumulative number of bytes read from tape:
  Cumulative number of compressed user bytes written to tape:
  Cumulative number of compressed user bytes read from tape:
  Current device temperature:
  Maximum device temperature this power on:
  Maximum device temperature for lifetime of drive:
  Minimum device temperature this power on:
  Minimum device temperature for lifetime of drive:
  Cumulative bytes written x 10000h on this tape:
  Cumulative bytes read x 10000h from this tape:
  Cumulative number of rewrites to this tape:
  Cumulative number of rereads from this tape:
  Cumulative blocks ECC corrected on this tape:
  Cumulative number of times this tape was paused:
  Cumulative number of rewinds on this tape:
  Number of tape repartitions:
  Current drive serial number:
  Previous bytes written x 10000h to tape:
  Previous bytes read x 10000h from tape:
  Previous # of rewrites:
  Previous # of rereads:
  Previous # of blocks ECC corrected:
  Previous # of times device paused:
  Previous # of rewinds:
  Previous # of tape repartitions:
  Previous drive serial number:
  Lifetime bytes written x 10000h to all tapes:
  Lifetime bytes read x 10000h from all tapes:
  Lifetime # of rewrites to all tapes:
  Lifetime # of rereads from all tapes:
  Lifetime # of blocks ECC corrected from all tapes:
  Lifetime # of times device paused on all tapes:
  Lifetime # of rewinds on all tapes:
  Lifetime # of tape repartitions on all tapes:
  Lifetime load count:
  Initial drive serial number:
  Tape serial number:
  Last FSC for tape 0 - least recent:
  Last motion command for tape 0:
  ID of tape 0:
  Last FSC for tape 1 - least recent:
  Last motion command for tape 1:
  ID of tape 1:
  Last FSC for tape 2 - least recent:
  Last motion command for tape 2:
  ID of tape 2:
  Last FSC for tape 3 - least recent:
  Last motion command for tape 3:
  ID of tape 3:
  Last FSC for tape 4 - least recent:
  Last motion command for tape 4:
```

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```
  ID of tape 4:

(EXABYTE) VXA TAPE VXA-2*
  Cumulative number of bytes written to tape:
  Cumulative number of bytes read from tape:
  Cumulative number of compressed user bytes written to tape:
  Cumulative number of compressed user bytes read from tape:
  Number of KB remaining on tape in partition 0:
  Number of KB remaining on tape in partition 1:
  Maximum KB that might be written to partition 0:
  Maximum KB that might be written to partition 1:
  Current device temperature:
  Maximum device temperature this power on:
  Maximum device temperature for lifetime of drive:
  Minimum device temperature this power on:
  Minimum device temperature for lifetime of drive:
  Number of minutes the drive has had tape tensioned in its lifetime:
  Number of minutes the drive has had tape tensioned since a cleaning tape was last used:
  Number of times a cleaning cartridge has been used on the drive in its lifetime:
  Cumulative bytes written x 10000h on this tape:
  Cumulative bytes read x 10000h from this tape:
  Cumulative number of rewrites to this tape:
  Cumulative number of rereads from this tape:
  Cumulative blocks ECC corrected on this tape:
  Cumulative number of times this tape was paused:
  Cumulative number of rewinds on this tape:
  Number of tape repartitions:
  Current drive serial number:
  Previous bytes written x 10000h to tape:
  Previous bytes read x 10000h from tape:
  Previous # of rewrites:
  Previous # of rereads:
  Previous # of blocks ECC corrected:
  Previous # of times device paused:
  Previous # of rewinds:
  Previous # of tape repartitions:
  Previous drive serial number:
  Lifetime bytes written x 10000h to all tapes:
  Lifetime bytes read x 10000h from all tapes:
  Lifetime # of rewrites to all tapes:
  Lifetime # of rereads from all tapes:
  Lifetime # of blocks ECC corrected from all tapes:
  Lifetime # of times device paused on all tapes:
  Lifetime # of rewinds on all tapes:
  Lifetime # of tape repartitions on all tapes:
  Lifetime load count:
  Initial drive serial number:
  Tape serial number:
  Last FSC for tape 0 - least recent:
  Last motion command for tape 0:
  ID of tape 0:
  Last FSC for tape 1 - least recent:
  Last motion command for tape 1:
  ID of tape 1:
  Last FSC for tape 2 - least recent:
  Last motion command for tape 2:
  ID of tape 2:
  Last FSC for tape 3 - least recent:
  Last motion command for tape 3:
  ID of tape 3:
  Last FSC for tape 4 - least recent:
  Last motion command for tape 4:
  ID of tape 4:

(FUJITSU) MAP3367*,MAP3735*,MAP3147*,MAS3367*,MAS3735*,MAT*,MAU*
  SMART status page, most significant byte:
  SMART data page, most significant byte:

(Any) HP35470*,HP35480*,C1533*,C1534*,C1536*,C1537*,C1539*,C1553*,C1557*,C5683A*,C5713A*
  Current number of Groups Written:
  Current number of RAW Retries:
```

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```
Current number of Groups Read:
Current number of ECC-3 Retries:
Previous number of Groups Written:
Previous number of RAW Retries:
Previous number of Groups Read:
Previous number of ECC-3 Retries:
Total number of Groups Written:
Total number of RAW Retries:
Total number of Groups Read:
Total number of ECC-3 Retries:
Load Count:
Remaining capacity in KB, partition 0:
Remaining capacity in KB, partition 1:
Maximum capacity it KB, partition 0:
Maximum capacity in KB, partition 1:
Number of frames written:
Main data C1 block write errors (positive tracks):
Main data C1 block write errors (negative tracks):
Sub area 0 C1 block write errors (positive tracks):
Sub area 1 C1 block write errors (positive tracks):
Sub area 0 C1 block write errors (negative tracks):
Sub area 1 C1 block write errors (negative tracks):
Number of frames read:
Main data C1 block read errors (positive tracks):
Main data C1 block read errors (negative tracks):
Sub area 0 C1 block read errors (positive tracks):
Sub area 1 C1 block read errors (positive tracks):
Sub area 0 C1 block read errors (negative tracks):
Sub area 1 C1 block read errors (negative tracks):
Total read retry count (frame logs only):
Total Read C2 uncorrectable blocks:
Number of groups that have not been successfully written because of drive failure:
Number of groups that have not been successfully read because of drive failure:
Faulty 12V (0=NO, 1=YES):
Drum has lost lock (0=NO, 1=YES):
Mode sensor fault (0=NO, 1=YES):
Tension too low (0=NO, 1=YES):
Bad diameter (0=NO, 1=YES):
Capstan stalled (0=NO, 1=YES):
Failed serial transfer (0=NO, 1=YES):
Drum stalled (0=NO, 1=YES):
Drum has lost lock (0=NO, 1=YES):
Drum PG lost (0=NO, 1=YES):
Tension too high (unable to calibrate tracking) (0=NO, 1=YES):
Mode expected lurking (0=NO, 1=YES):
Mode time-out (0=NO, 1=YES):
Capstan stop time-out (0=NO, 1=YES):
Reels stop time-out (0=NO, 1=YES):
Supply reel stuck threading (0=NO, 1=YES):
Supply reel stuck capstan mode (0=NO, 1=YES):
Capstan clean slip (0=NO, 1=YES):
Take-up reel struck capstan mode (0=NO, 1=YES):
Reels stuck reel mode (0=NO, 1=YES):
Reels spinning threading (0=NO, 1=YES):
Drum stop time-out (0=NO, 1=YES):
Calibration error (0=NO, 1=YES):
Supply reel stuck during motion (0=NO, 1=YES):
ROM check fail (0=NO, 1=YES):
Supply reel stuck during motion (0=NO, 1=YES):
Take-up reel spin during motion (0=NO, 1=YES):
Take-up reel spin during motion (0=NO, 1=YES):
Download incompatible (0=NO, 1=YES):
Servo busy (0=NO, 1=YES):
Servo hung (0=NO, 1=YES):
Number of entities written:
Number of entities read:
Number of records written:
Number of records read:
Kilobytes to data compression:
Kilobytes from data compression:
Kilobytes to tape:
```

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```
  Kilobytes from tape:
  Logical entity size:
  Physical entity size:
  Uncompressed entities:

(Any) C7438A*
  Faulty 12V (0=NO, 1=YES):
  Drum has lost lock (0=NO, 1=YES):
  Mode sensor fault (0=NO, 1=YES):
  Tension too low (0=NO, 1=YES):
  Bad diameter (0=NO, 1=YES):
  Capstan stalled (0=NO, 1=YES):
  Failed serial transfer (0=NO, 1=YES):
  Drum stalled (0=NO, 1=YES):
  Drum has lost lock (0=NO, 1=YES):
  Drum PG lost (0=NO, 1=YES):
  Tension too high (unable to calibrate tracking) (0=NO, 1=YES):
  Mode expected lurking (0=NO, 1=YES):
  Mode time-out (0=NO, 1=YES):
  Capstan stop time-out (0=NO, 1=YES):
  Reels stop time-out (0=NO, 1=YES):
  Supply reel stuck threading (0=NO, 1=YES):
  Supply reel stuck capstan mode (0=NO, 1=YES):
  Capstan clean slip (0=NO, 1=YES):
  Take-up reel struck capstan mode (0=NO, 1=YES):
  Reels stuck reel mode (0=NO, 1=YES):
  Reels spinning threading (0=NO, 1=YES):
  Drum stop time-out (0=NO, 1=YES):
  Calibration error (0=NO, 1=YES):
  Supply reel stuck during motion (0=NO, 1=YES):
  ROM check fail (0=NO, 1=YES):
  Supply reel stuck during motion (0=NO, 1=YES):
  Take-up reel spin during motion (0=NO, 1=YES):
  Take-up reel spin during motion (0=NO, 1=YES):
  Download incompatible (0=NO, 1=YES):
  Servo busy (0=NO, 1=YES):
  Servo hung (0=NO, 1=YES):
  Current number of Groups Written:
  Current number of RAW Retries:
  Current number of Groups Read:
  Current number of ECC-3 Retries:
  Previous number of Groups Written:
  Previous number of RAW Retries:
  Previous number of Groups Read:
  Previous number of ECC-3 Retries:
  Total number of Groups Written:
  Total number of RAW Retries:
  Total number of Groups Read:
  Total number of ECC-3 Retries:
  Load Count:
  Remaining capacity in KB, partition 0:
  Remaining capacity in KB, partition 1:
  Maximum capacity it KB, partition 0:
  Maximum capacity in KB, partition 1:
  Number of frames written:
  Main data C1 block write errors (positive tracks):
  Main data C1 block write errors (negative tracks):
  Sub area 0 C1 block write errors (positive tracks):
  Sub area 1 C1 block write errors (positive tracks):
  Sub area 0 C1 block write errors (negative tracks):
  Sub area 1 C1 block write errors (negative tracks):
  Number of frames read:
  Main data C1 block read errors (positive tracks):
  Main data C1 block read errors (negative tracks):
  Sub area 0 C1 block read errors (positive tracks):
  Sub area 1 C1 block read errors (positive tracks):
  Sub area 0 C1 block read errors (negative tracks):
  Sub area 1 C1 block read errors (negative tracks):
  Total read retry count (frame logs only):
  Total Read C2 uncorrectable blocks:
  Number of entities written:
```

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```
  Number of entities read:
  Number of records written:
  Number of records read:
  Kilobytes to data compression:
  Kilobytes from data compression:
  Kilobytes to tape:
  Kilobytes from tape:
  Logical entity size:
  Physical entity size:
  Uncompressed entities:

(HITACHI) DK31CJ*,DK32CJ*,DK32DJ*
  Non-medium track following errors:
  Non-medium positioning errors:

(HITACHI) DK32EJ*,HUS103030*,HUS103014*,HUS103073*,HUS103036*
  Non-medium track following errors:
  Non-medium positioning errors:
  Specified cycle count over device lifetime (nonvolatile):
  Accumulated cycle count over device lifetime:
  Power on time (in minutes):
  Next S.M.A.R.T. Measurement time:

(HITACHI) HUS??????VLS300
  Invalid DWORD count:
  Disparity error count:
  Loss of DWORD sync count:
  Phy reset problem count:
  # of Zero-length seeks:
  # Seeks >= 2/3 of disk:
  # Seeks >= 1/3 and < 2/3 of disk:
  # Seeks >= 1/6 and < 1/3 of disk:
  # Seeks >= 0 and < 1/6 of disk:
  # Seeks > 0 and < 1/12 of disk:
  Overrun counter - times data available but not retrieved on pass:
  Underrun counter - times disk was ready to write but buffer empty:
  Device cache full read hits:
  Device cache partial read hits:
  Device cache write hits:
  Device cache fast writes:
  Device cache read misses:
  Power on time (in hours):
  Max drive temp (C):
  GLIST size:
  Number of PFA Occurrences:
  Total read commands:
  Total write commands:

(HITACHI) HUC101???CSS300,HUS??????VLF?00,HUS??????VL3?00
  # of Zero-length seeks:
  # Seeks >= 2/3 of disk:
  # Seeks >= 1/3 and < 2/3 of disk:
  # Seeks >= 1/6 and < 1/3 of disk:
  # Seeks >= 0 and < 1/6 of disk:
  # Seeks > 0 and < 1/12 of disk:
  Overrun counter - times data available but not retrieved on pass:
  Underrun counter - times disk was ready to write but buffer empty:
  Device cache full read hits:
  Device cache partial read hits:
  Device cache write hits:
  Device cache fast writes:
  Device cache read misses:
  Power on time (in hours):
  Max drive temp (C):
  GLIST size:
  Number of PFA Occurrences:
  Total read commands:
  Total write commands:

(HITACHI) HUC1030*,HUS1514*
  # of Zero-length seeks:
```

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```
  # Seeks >= 2/3 of disk:
  # Seeks >= 1/3 and < 2/3 of disk:
  # Seeks >= 1/6 and < 1/3 of disk:
  # Seeks >= 0 and < 1/6 of disk:
  # Seeks > 0 and < 1/12 of disk:
  Overrun counter - times data available but not retrieved on pass:
  Underrun counter - times disk was ready to write but buffer empty:
  Device cache full read hits:
  Device cache partial read hits:
  Device cache write hits:
  Device cache fast writes:
  Device cache read misses:
  B 0004 %d Device cache read misses:
  DG146BAAJB:
  Invalid DWORD count:
  Disparity error count:
  Loss of DWORD sync count:
  Phy reset problem count:
  # of Zero-length seeks:
  # Seeks >= 2/3 of disk:
  # Seeks >= 1/3 and < 2/3 of disk:
  # Seeks >= 1/6 and < 1/3 of disk:
  # Seeks >= 0 and < 1/6 of disk:
  # Seeks > 0 and < 1/12 of disk:
  Overrun counter - times data available but not retrieved on pass:
  Underrun counter - times disk was ready to write but buffer empty:
  Device cache full read hits:
  Device cache partial read hits:
  Device cache write hits:
  Device cache fast writes:
  Device cache read misses:
  Power on time (in hours):
  Max drive temp (C):
  GLIST size:
  Number of PFA Occurrences:
  Total read commands:
  Total write commands:

(IBM*) 03570*
  # of blocks corrected on writes for cartridge:
  Servo transient condition count on writes for cartridge:
  # of RDF/ECC transient conditions on writes for cartridge:
  # of write velocity errors on cartridge:
  # of servo data acquisition write errors on cartridge:
  # of RDF data acquisition write errors on cartridge:
  # of servo data write errors on cartridge:
  # of ECC data write errors on cartridge:
  # of total write retries on cartridge:
  # of Belcord Actions on writes on cartridge:
  # of servo demark blocks written on cartridge:
  # of volume control region write errors on cartridge:
  # of blocks lifted for writes on cartridge:
  # of write gap misses on cartridge:
  # of blocks corrected on reads for cartridge:
  Servo transient condition count on reads for cartridge:
  # of RDF/ECC transient conditions on reads for cartridge:
  # of read velocity errors on cartridge:
  # of servo data acquisition read errors on cartridge:
  # of RDF data acquisition read errors on cartridge:
  # of servo data read errors on cartridge:
  # of ECC data read errors on cartridge:
  # of total sequence read errors on cartridge:
  # of total read opposite errors on cartridge:
  # of times tension adjusted higher than normal for read on cartridge:
  # of times tension adjusted higher than normal for read on cartridge:
  # of servo (set too high) read errors on cartridge:
  # of servo (set too low) read errors on cartridge:
  # of recovered read errors (dead reckoning nominal) on cartridge:
  # of recovered read errors (dead reckoning high) on cartridge:
  # of recovered read errors (dead reckoning low) on cartridge:
  # of recovered read errors (filter coefficients changed) on cartridge:
```

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```
# of recovered read errors (opposite gap) on cartridge:
# of total read retries on cartridge:
# of Belcord Actions on reads on cartridge:
# of volume control region read errors on cartridge:
# of cartridge initialization errors on tape load:
# of read gap misses on cartridge:
# of servo demarks read on cartridge:
# of blocks corrected on read reverses for cartridge:
Servo transient condition count on read reverses for cartridge:
# of RDF/ECC transient conditions on read reverses for cartridge:
# of read reverse velocity errors on cartridge:
# of servo data acquisition read reverse errors on cartridge:
# of RDF data acquisition read reverse errors on cartridge:
# of servo data read reverse errors on cartridge:
# of ECC data read reverse errors on cartridge:
# of total sequence read reverse errors on cartridge:
# of total read reverse opposite errors on cartridge:
# of times tension adjusted higher than normal for read reverse on cartridge:
# of times tension adjusted higher than normal for read reverse on cartridge:
# of servo (set too high) read reverse errors on cartridge:
# of servo (set too low) read reverse errors on cartridge:
# of recovered read reverse errors (dead reckoning nominal) on cartridge:
# of recovered read reverse errors (dead reckoning high) on cartridge:
# of recovered read reverse errors (dead reckoning low) on cartridge:
# of recovered read reverse errors (filter coefficients changed) on cartridge:
# of recovered read reverse errors (opposite gap) on cartridge:
# of total read reverse retries on cartridge:
# of Belcord Actions on read reverse on cartridge:
# of volume control region read reverse errors on cartridge:
# of cartridge initialization read reverse errors on tape load:
# of read reverse gap misses on cartridge:
# of servo demarks read reverse on cartridge:
# of SCSI write blocks processed:
# of SCSI write Kbytes processed:
# of SCSI read blocks processed:
# of SCSI read Kbytes processed:
# of device write blocks processed:
# of device write Kbytes processed:
# of device read blocks processed:
# of device read Kbytes processed:
# of device write blocks transferred:
# of device write Kbytes transferred:
# of device read blocks transferred:
# of device read Kbytes transferred:
Nominal capacity of partition in Kbytes:
Fractional part of partition currently traversed:
Nominal capacity of the volume in Kbytes:
Fractional part of the volume currently traversed:
# of SCSI protocol errors:
# of SCSI aborts:
# of SCSI bus resets:
# of operator panel errors:
# of SCSI protocol chip errors:
# of SCSI buffer errors:
# of compactor errors:
# of formatter errors:
# of data flow hardware errors:
# of ECC hardware errors:
# of analog hardware errors:
# of mailbox interface errors:
# of library errors:
# of library failures of put to drive actions:
# of library failures of get from drive actions:
# of library failures of put to magazine actions:
# of library failures of get from magazine actions:
# of library failures of put to priority cell actions:
# of library failures of get from priority cell actions:
# of library pinch motor errors:
# of library feed motor errors:
# of library elevator motor errors:
# of library moves:
```

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```
  # of library recalibrations:
  # of library drive mounts:
  # of library priority cell mounts:
  # of library magazine cell mounts:
  # of library cleaning mounts to device:
  # of library volume lifetime mounts:
  Volume lifetime megabytes written:
  Volume lifetime megabytes read:
  # of drive lifetime mounts:
  # of drive lifetime megabytes written:
  # of drive lifetime megabytes read:

(IBM*) ULT3580*
  Thread count:
  Total data sets written:
  Total write retries:
  Total unrecovered write errors:
  Total suspended writes:
  Total fatal suspended writes:
  Total data sets read:
  Total read retries:
  Total unrecovered read errors:
  Total suspended reads:
  Total fatal suspended reads:
  Main partition remaining capacity (megabytes):
  Alternate partition remaining capacity (megabytes):
  Main partition maximum capacity (megabytes):
  Alternate partition maximum capacity (megabytes):
  Read compression ratio x 100:
  Write compression ratio x 100:
  Megabytes transferred to server:
  Bytes transferred to server:
  Megabytes read from tape:
  Bytes read from tape:
  Megabytes transferred from server:
  Bytes transferred from server:
  Megabytes written to tape:
  Bytes written to tape:

(IBM*) 03590*
  # of blocks corrected on writes for cartridge:
  Servo transient condition count on writes for cartridge:
  # of RDF/ECC transient conditions on writes for cartridge:
  # of write velocity errors on cartridge:
  # of servo data acquisition write errors on cartridge:
  # of RDF data acquisition write errors on cartridge:
  # of servo data write errors on cartridge:
  # of ECC data write errors on cartridge:
  # of total write retries on cartridge:
  # of Belcord Actions on writes on cartridge:
  # of servo demark blocks written on cartridge:
  # of volume control region write errors on cartridge:
  # of blocks lifted for writes on cartridge:
  # of write gap misses on cartridge:
  # of blocks corrected on reads for cartridge:
  Servo transient condition count on reads for cartridge:
  # of RDF/ECC transient conditions on reads for cartridge:
  # of read velocity errors on cartridge:
  # of servo data acquisition read errors on cartridge:
  # of RDF data acquisition read errors on cartridge:
  # of servo data read errors on cartridge:
  # of ECC data read errors on cartridge:
  # of total sequence read errors on cartridge:
  # of total read opposite errors on cartridge:
  # of times tension adjusted higher than normal for read on cartridge:
  # of times tension adjusted higher than normal for read on cartridge:
  # of servo (set too high) read errors on cartridge:
  # of servo (set too low) read errors on cartridge:
  # of recovered read errors (dead reckoning nominal) on cartridge:
  # of recovered read errors (dead reckoning high) on cartridge:
  # of recovered read errors (dead reckoning low) on cartridge:
```

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```
# of recovered read errors (filter coefficients changed) on cartridge:
# of recovered read errors (opposite gap) on cartridge:
# of total read retries on cartridge:
# of Belcord Actions on reads on cartridge:
# of volume control region read errors on cartridge:
# of cartridge initialization errors on tape load:
# of read gap misses on cartridge:
# of servo demarks read on cartridge:
# of blocks corrected on read reverses for cartridge:
Servo transient condition count on read reverses for cartridge:
# of RDF/ECC transient conditions on read reverses for cartridge:
# of read reverse velocity errors on cartridge:
# of servo data acquisition read reverse errors on cartridge:
# of RDF data acquisition read reverse errors on cartridge:
# of servo data read reverse errors on cartridge:
# of ECC data read reverse errors on cartridge:
# of total sequence read reverse errors on cartridge:
# of total read reverse opposite errors on cartridge:
# of times tension adjusted higher than normal for read reverse on cartridge:
# of times tension adjusted higher than normal for read reverse on cartridge:
# of servo (set too high) read reverse errors on cartridge:
# of servo (set too low) read reverse errors on cartridge:
# of recovered read reverse errors (dead reckoning nominal) on cartridge:
# of recovered read reverse errors (dead reckoning high) on cartridge:
# of recovered read reverse errors (dead reckoning low) on cartridge:
# of recovered read reverse errors (filter coefficients changed) on cartridge:
# of recovered read reverse errors (opposite gap) on cartridge:
# of total read reverse retries on cartridge:
# of Belcord Actions on read reverse on cartridge:
# of volume control region read reverse errors on cartridge:
# of cartridge initialization read reverse errors on tape load:
# of read reverse gap misses on cartridge:
# of servo demarks read reverse on cartridge:
# of SCSI write blocks processed:
# of SCSI write Kbytes processed:
# of SCSI read blocks processed:
# of SCSI read Kbytes processed:
# of device write blocks processed:
# of device write Kbytes processed:
# of device read blocks processed:
# of device read Kbytes processed:
# of device write blocks transferred:
# of device write Kbytes transferred:
# of device read blocks transferred:
# of device read Kbytes transferred:
Nominal capacity of partition in Kbytes:
Fractional part of partition currently traversed:
Nominal capacity of the volume in Kbytes:
Fractional part of the volume currently traversed:
# of SCSI protocol errors (port 0):
# of SCSI aborts (port 0):
# of SCSI bus resets (port 0):
# of SCSI protocol errors (port 0):
# of SCSI aborts (port 0):
# of SCSI bus resets (port 0):
# of operator panel errors:
# of SCSI protocol chip errors:
# of SCSI buffer errors:
# of compactor errors:
# of formatter errors:
# of data flow hardware errors:
# of ECC hardware errors:
# of analog hardware errors:
# of mailbox interface errors:
# of library errors:
# of library failures of put to drive actions:
# of library failures of get from drive actions:
# of library failures of put to magazine actions:
# of library failures of get from magazine actions:
# of library failures of put to priority cell actions:
# of library failures of get from priority cell actions:
```

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```
  # of library pinch motor errors:
  # of library feed motor errors:
  # of library elevator motor errors:
  # of library moves:
  # of library recalibrations:
  # of library drive mounts:
  # of library priority cell mounts:
  # of library magazine cell mounts:
  # of library cleaning mounts to device:
  # of library volume lifetime mounts:
  Volume lifetime megabytes written:
  Volume lifetime megabytes read:
  # of drive lifetime mounts:
  # of drive lifetime megabytes written:
  # of drive lifetime megabytes read:

(IBM*) DFHC*
  # of Zero-length seeks:
  # Seeks >= 2/3 of disk:
  # Seeks >= 1/3 and < 2/3 of disk:
  # Seeks >= 1/6 and < 1/3 of disk:
  # Seeks >= 0 and < 1/6 of disk:
  # Seeks > 0 and < 1/12 of disk:
  Overrun counter - times data available but not retrieved on pass:
  Underrun counter - times disk was ready to write but buffer empty:
  Device cache full read hits:
  Device cache partial read hits:
  Device cache write hits:
  Device cache fast writes:

(IBM*) DCHC*
  # of Zero-length seeks:
  # Seeks >= 2/3 of disk:
  # Seeks >= 1/3 and < 2/3 of disk:
  # Seeks >= 1/6 and < 1/3 of disk:
  # Seeks >= 0 and < 1/6 of disk:
  # Seeks > 0 and < 1/12 of disk:
  Overrun counter - times data available but not retrieved on pass:
  Underrun counter - times disk was ready to write but buffer empty:
  Device cache full read hits:
  Device cache partial read hits:
  Device cache write hits:
  Device cache fast writes:

(IBM*) DGHC*
  # of Zero-length seeks:
  # Seeks >= 2/3 of disk:
  # Seeks >= 1/3 and < 2/3 of disk:
  # Seeks >= 1/6 and < 1/3 of disk:
  # Seeks >= 0 and < 1/6 of disk:
  # Seeks > 0 and < 1/12 of disk:
  Overrun counter - times data available but not retrieved on pass:
  Underrun counter - times disk was ready to write but buffer empty:
  Device cache full read hits:
  Device cache partial read hits:
  Device cache write hits:
  Device cache fast writes:
  Current temperature (in centigrade):

(IBM*) DGHS*,DGVS*
  # of Zero-length seeks:
  # Seeks >= 2/3 of disk:
  # Seeks >= 1/3 and < 2/3 of disk:
  # Seeks >= 1/6 and < 1/3 of disk:
  # Seeks >= 0 and < 1/6 of disk:
  # Seeks > 0 and < 1/12 of disk:
  Overrun counter - times data available but not retrieved on pass:
  Underrun counter - times disk was ready to write but buffer empty:
  Device cache full read hits:
  Device cache partial read hits:
  Device cache write hits:
```

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```
  Device cache fast writes:
  Temperature (Centigrade):

(IBM*) DRHS*,DRVS*
  # of Zero-length seeks:
  # Seeks >= 2/3 of disk:
  # Seeks >= 1/3 and < 2/3 of disk:
  # Seeks >= 1/6 and < 1/3 of disk:
  # Seeks >= 0 and < 1/6 of disk:
  # Seeks > 0 and < 1/12 of disk:
  Overrun counter - times data available but not retrieved on pass:
  Underrun counter - times disk was ready to write but buffer empty:
  Device cache full read hits:
  Device cache partial read hits:
  Device cache write hits:
  Device cache fast writes:
  Temperature (Centigrade):

(IBM*) DMV*
  # of Zero-length seeks:
  # Seeks >= 2/3 of disk:
  # Seeks >= 1/3 and < 2/3 of disk:
  # Seeks >= 1/6 and < 1/3 of disk:
  # Seeks >= 0 and < 1/6 of disk:
  # Seeks > 0 and < 1/12 of disk:
  Overrun counter - times data available but not retrieved on pass:
  Underrun counter - times disk was ready to write but buffer empty:
  Device cache full read hits:
  Device cache partial read hits:
  Device cache write hits:
  Device cache fast writes:
  Cumulative Cache Full hits on reads:
  Cumulative Cache Partial hits on reads:
  Cumulative Cache Misses on reads:
  Temperature (Centigrade):

(IBM OEM) DFHS*,DFMS*
  # of Zero-length seeks:
  # Seeks >= 2/3 of disk:
  # Seeks >= 1/3 and < 2/3 of disk:
  # Seeks >= 1/6 and < 1/3 of disk:
  # Seeks >= 0 and < 1/6 of disk:
  # Seeks > 0 and < 1/12 of disk:
  Overrun counter - times data available but not retrieved on pass:
  Underrun counter - times disk was ready to write but buffer empty:
  Device cache full read hits:
  Device cache partial read hits:
  Device cache write hits:
  Device cache fast writes:

(IBM OEM) DRHL*,DRVL*
  # of Zero-length seeks:
  # Seeks >= 2/3 of disk:
  # Seeks >= 1/3 and < 2/3 of disk:
  # Seeks >= 1/6 and < 1/3 of disk:
  # Seeks >= 0 and < 1/6 of disk:
  # Seeks > 0 and < 1/12 of disk:
  Overrun counter - times data available but not retrieved on pass:
  Underrun counter - times disk was ready to write but buffer empty:
  Device cache full read hits:
  Device cache partial read hits:
  Device cache write hits:
  Device cache fast writes:
  Temperature (Centigrade):

(IBM OEM) DCHS*,DCMS*
  # of Zero-length seeks:
  # Seeks >= 2/3 of disk:
  # Seeks >= 1/3 and < 2/3 of disk:
  # Seeks >= 1/6 and < 1/3 of disk:
  # Seeks >= 0 and < 1/6 of disk:
```

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```
  # Seeks > 0 and < 1/12 of disk:
  Overrun counter - times data available but not retrieved on pass:
  Underrun counter - times disk was ready to write but buffer empty:
  Device cache full read hits:
  Device cache partial read hits:
  Device cache write hits:
  Device cache fast writes:

(ENGENIO) *
  Time (ms) since last statistical reset:
  LUN abort count:
  Logical unit driver version: (alphanumeric)
  Total requests serviced:
  Total number of blocks requested:
  Number of read requests:
  Read requests - number of blocks:
  Number of write requests:
  Write requests - number of blocks:
  Percentage of reads to total IOs (0 to 100):
  Average number of blocks requested:
  Quick check of cache hits:
  Quick check cache hits number of blocks:
  Number of reads treated as large read:
  Large read - number of blocks:
  Number of writes treated as large writes:
  Large writes - number of blocks:
  Total number of stripes read:
  Total number of clusters read:
  Total number of stripes written:
  Total number of clusters written:
  Total number of grouped write operations:
  Number of reads/writes using alg. 1:
  Number of reads/writes using alg. 2:
  Number of reads/writes using alg. 3:
  Number of reads/writes using alg. 4:
  Number of reads/writes using alg. 5:
  Number of reads/writes using alg. 6:
  Number of data repair operations attempted:
  Number of data repair reconstructs successes:
  Number of failed repair requests:
  Number of RPA requests:
  Total RPA request width:
  Total RPA request depth:
  Total number cache read requests:
  Total number of cache read current data requests:
  Total number of cache read requests for old data:
  Total number of cache read requests for current parity:
  Total number of cache read requests for old parity:
  Total number of disk reads from cache:
  Total number cache read checks:
  Total number of cache read check hits:
  Total number of cache full segment over writes:
  Total number of cache partial segment over writes:
  Total number of write requests from cache:
  Busy/queue full count:
  Host Interface errors count:
  Current queue depth:
  Non simple Q-Tag count:
  Host driver reselect request count:
  Host driver interrupt count:
  Total number of SCSI structures:
  Number of SCSI structures in use:
  Total number of ISRs:
  Total of interrupts serviced on fly:
  (RAID Controller) cumulative time (in ms) since last statistical reset:
  (Host interface) Busy/queue full count:
  (Host interface) Source errors count:
  (Host interface) Non simple Q-Tag count:
  (Host interface) Src driver reselect request count:
  (Host interface) Src driver interrupt count:
  (Host interface) Error count by initiator:
```

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```
  (Controller) Total requests serviced:
  (Controller) Total number blocks requested:
  (Controller) Number of read requests:
  (Controller) Read requests number of blocks:
  (Controller) Number of write requests:
  (Controller) Write requests number of blocks:
  (Controller) Quick check cache hits:
  (Controller) Quick check cache hits number of blocks:
  (Controller) Number of reads treated as large read:
  (Controller) Large read number of blocks:
  (Controller) Number of writes treated as large writes:
  (Controller) Large write number of blocks:
  (Controller) Total number of complete stripes read:
  (Controller) Total number of clusters read:
  (Controller) Total number of complete stripes written:
  (Controller) Total number of clusters written:
  (Controller) Total number of grouped write operations:
  (Controller) Number of reads/writes using alg. 1:
  (Controller) Number of reads/writes using alg. 2:
  (Controller) Number of reads/writes using alg. 3:
  (Controller) Number of reads/writes using alg. 4:
  (Controller) Number of reads/writes using alg. 5:
  (Controller) Number of reads/writes using alg. 6:
  (Controller) Number of data repair operations attempted:
  (Controller) Number of data repair reconstructs successes:
  (Controller) Number of failed repair requests:
  (Controller) Number of RPA requests:
  (Controller) Avg. RPA request width:
  (Controller) Avg. RPA request depth:
  (Controller) Total number cache read requests:
  (Controller) Total number of cache read current data requests:
  (Controller) Total number of cache read requests for old data:
  (Controller) Total number of cache read requests for current parity:
  (Controller) Total number of cache read requests for old parity:
  (Controller) Total number of disk reads from cache:
  (Controller) Total number cache read checks:
  (Controller) Total number of cache read check hits:
  (Controller) Total number of cache full segment over writes:
  (Controller) Total number of cache partial segment over writes:
  (Controller) Total number of write requests from cache:
  Total number of SCSI structures:
  Number of SCSI Structures in use:
  Total number of ISRs:
  Total of interrupts serviced on fly:

(QUANTUM) UHDL*
  Total number of superloader moves:
  Total number of drive loads:
  Total number of mail slot imports:
  Total number of mail slot exports:
  Total number of magazine moves:
  Total number of magazine loads:
  Total number of servo hard errors:
  Total number of drive soft errors:
  Total number of left magazine soft errors:
  Total number of right magazine soft errors:
  Total number of mail slot soft errors:
  Total number of rotation recovery actions:
  Total number of translation recovery actions:
  Total number of left magazine recovery actions:
  Total number of right magazine recovery actions:

(QUANTUM) SUPERDLT1*,SDLT 320*
  Total write errors since last read:
  Total write error flags:
  Total dropout error count (on writes):
  Total servo tracking errors (on writes):
  Total dropout error count (on writes):
  Total read errors since last write:
  Read compression ratio x 100:
  Write compression ratio x 100:
```

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```
     Total MB transferred to host:
     Total bytes transferred to host:
     Total MB read from tape:
     Total bytes read from tape:
     Total MB transferred from host:
     Total bytes transferred from host:
     Total MB written to tape:
     Total bytes written to tape:
     Cleaning status mask (4=Required, 2=Requested, 1=Cleaning tape expired):
     Total loads over lifetime of drive:
     Drive temperature in degrees C:
     Media ID of most recently used cartridge:
     Controller serial number (least significant 16 bits):
     Drive cleaning cycle count:

   (SEAGATE) CTT8000*,STT2000*
     ECC Corrections on even tracks:
     ECC Corrections on odd tracks:
     Read retries on even tracks:
     Read retries on odd tracks:

   (Any)
S?173404F*,S?318304F*,S?318451F*,S?318453F*,S?336605F*,S?336704F*,S?373405F*,S?336753F*,S?373453F*,S?3146707
F*,S?3300007F*,S?373207F*,S?3146854F*,S?373454F*,S?336754F*,ST373207FC
     Port receiving this command 0=A, 1=B:
     Port A link failure count:
     Port A loss of synchronization count:
     Port A invalid transmission word count:
     Port A invalid CRC count:
     # of initialize LIPs that this drive generated from Port A:
     # of initialize LIPs that this drive received on Port A:
     # of failure LIPs that this drive generated from Port A:
     # of failure LIPs that this drive received on Port A:
     Port B link failure count:
     Port B loss of synchronization count:
     Port B invalid transmission word count:
     Port B invalid CRC count:
     # of initialize LIPs that this drive generated from Port B:
     # of initialize LIPs that this drive received on Port B:
     # of failure LIPs that this drive generated from Port B:
     # of failure LIPs that this drive received on Port B:
     Logical blocks sent to initiators:
     Logical blocks received from initiators:
     Logical blocks read from cache, sent to initiators:
     Number of read and write commands <= current segment size:
     Number of read and write commands > current segment size:
     Power-on time in minutes:
     Time in minutes until the next scheduled interrupt for a S.M.A.R.T. measurement:

   (Any)
S?136403F*,ST3146807F*,ST3146855F*,S?318452F*,S?373307F*,ST373455F*,ST3300655F*,S?336607F*,S?336752F*
     Port receiving this command 0=A, 1=B:
     Port A link failure count:
     Port A loss of synchronization count:
     Port A invalid transmission word count:
     Port A invalid CRC count:
     # of initialize LIPs that this drive generated from Port A:
     # of initialize LIPs that this drive received on Port A:
     # of failure LIPs that this drive generated from Port A:
     # of failure LIPs that this drive received on Port A:
     Port B link failure count:
     Port B loss of synchronization count:
     Port B invalid transmission word count:
     Port B invalid CRC count:
     # of initialize LIPs that this drive generated from Port B:
     # of initialize LIPs that this drive received on Port B:
     # of failure LIPs that this drive generated from Port B:
     # of failure LIPs that this drive received on Port B:
     Logical blocks sent to initiators:
     Logical blocks received from initiators:
     Logical blocks read from cache, sent to initiators:
```

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```
     Number of read and write commands <= current segment size:
     Number of read and write commands > current segment size:
     Power-on time in minutes:
     Time in minutes until the next scheduled interrupt for a S.M.A.R.T. measurement:

   (Any)
ST3146707L*,ST3300007L*,ST373207LW,ST373454SS,ST3400755SS,ST973401SS,ST936701SS,,S?19171L,S?318432L*,S?31843
6*,S?318452L*,S?39226*,S?39236*,S?39175*,S?39173*,S?336732L*,S?336752L*,ST973?01SS,DG072A8B54*,ST3400755F*,S
T330095F*,ST3146356SS,ST3300656SS,ST3450856SS,ST3450856F*,ST3300656F*,ST3146356F*
     Logical blocks sent to initiators:
     Logical blocks received from initiators:
     Logical blocks read from cache, sent to initiators:
     Number of read and write commands <= current segment size:
     Number of read and write commands > current segment size:
     Power-on time in minutes:
     Time in minutes until the next scheduled interrupt for a S.M.A.R.T. measurement:

   (Any) S?136404L*
     Logical blocks sent to initiators:
     Logical blocks received from initiators:
     Logical blocks read from cache, sent to initiators:
     Number of read and write commands <= current segment size:
     Number of read and write commands > current segment size:

   (Any) S?1181677F*
     Port receiving this command 0=A, 1=B:
     Port A link failure count:
     Port A loss of synchronization count:
     Port A invalid transmission word count:
     Port A invalid CRC count:
     # of initialize LIPs that this drive generated from Port A:
     # of initialize LIPs that this drive received on Port A:
     # of failure LIPs that this drive generated from Port A:
     # of failure LIPs that this drive received on Port A:
     Port B link failure count:
     Port B loss of synchronization count:
     Port B invalid transmission word count:
     Port B invalid CRC count:
     # of initialize LIPs that this drive generated from Port B:
     # of initialize LIPs that this drive received on Port B:
     # of failure LIPs that this drive generated from Port B:
     # of failure LIPs that this drive received on Port B:
     Logical blocks sent to initiators:
     Logical blocks received from initiators:
     Logical blocks read from cache, sent to initiators:
     Number of read and write commands <= current segment size:
     Number of read and write commands > current segment size:

   (Any)
ST310000640SS,ST3146854SS,ST3146855SS,ST3300655SS,ST336754SS,ST373451SS,ST37344SS,ST373455SS,ST3750630SS,ST3
500620SS,ST9146802SS,ST396751SS,ST973451SS,ST936751SS,ST973402SS
     Logical blocks sent to initiators:
     Logical blocks received from initiators:
     Logical blocks read from cache, sent to initiators:
     Number of read and write commands <= current segment size:
     Number of read and write commands > current segment size:
     Power-on time in minutes:
     Time in minutes until the next scheduled interrupt for a S.M.A.R.T. measurement:

   (Any)
BD0096349A,BD018122C0,S?1181677L*,S?173404L*,S?3146807L*,S?318203L,S?318233*,S?318404L*,S?318406L*,S?318405*
,S?318451L*,S?318453L*,S?336605L*,S?336607L*,S?336704L*,S?336706L*,S?336705L*,S?336753L*,S?373307L*,S?373405
L*,S?373453L*,S?39133*,S?39204L*,S?39205L*,S?39251L*,S?3146854L*,S?373454L*,S?336754L*
     Logical blocks sent to initiators:
     Logical blocks received from initiators:
     Logical blocks read from cache, sent to initiators:
     Number of read and write commands <= current segment size:
     Number of read and write commands > current segment size:
     Cumulative drive power-on minutes:
     Time in minutes until next scheduled SMART test:
     Time in minutes until the next scheduled interrupt for a S.M.A.R.T. measurement:
```

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```
   (Any) S?318305L*
     Year, week this device was manufactured:
     Specified max start-stop cycle count:
     Accumulated start-stop cycles:
     Logical blocks sent to initiators:
     Logical blocks received from initiators:
     Logical blocks read from cache, sent to initiators:
     Number of read and write commands <= current segment size:
     Number of read and write commands > current segment size:
     Power-on time in minutes:
     Time in minutes until the next scheduled interrupt for a S.M.A.R.T. measurement:

   (Any) S?318405L*,ST150176F*
     Logical blocks sent to initiators:
     Logical blocks received from initiators:
     Logical blocks read from cache, sent to initiators:
     Number of read and write commands <= current segment size:
     Number of read and write commands > current segment size:
     Power-on time in minutes:
     Time in minutes until the next scheduled interrupt for a S.M.A.R.T. measurement:

   (Any) S?118273*,S?34573*
     Logical blocks sent to initiators:
     Logical blocks received from initiators:
     Logical blocks read from cache, sent to initiators:
     Number of read and write commands <= current segment size:
     Number of read and write commands > current segment size:

   (Any)
S?136475*,S?150176L,S?318275*,S?318417*,S?318418*,S?318438*,S?31975*,S?32171*,S?32271*,S?32272*,S?336737*,S?
336918*,S?336938*,S?34371*,S?34571*,S?34572*
     Logical blocks sent to initiators:
     Logical blocks received from initiators:
     Logical blocks read from cache, sent to initiators:
     Number of read and write commands <= current segment size:
     Number of read and write commands > current segment size:

   (Any) S?118202L*,S?19101N*,S?19101W*,S?34501N*,S?34501W*,S?34502L*,S?39102*,S?39103F*
     Logical blocks sent to initiators:
     Logical blocks received from initiators:
     Logical blocks read from cache, sent to initiators:
     Number of read and write commands <= current segment size:
     Number of read and write commands > current segment size:

   (Any) S?118202F*,S?34501F*
     Logical blocks sent to initiators:
     Logical blocks received from initiators:
     Logical blocks read from cache, sent to initiators:
     Number of read and write commands <= current segment size:
     Number of read and write commands > current segment size:
     Power-on time in minutes:
     Time in minutes until the next scheduled interrupt for a S.M.A.R.T. measurement:

   (Any) S?19101F*
     Logical blocks sent to initiators:
     Logical blocks received from initiators:
     Logical blocks read from cache, sent to initiators:
     Number of read and write commands <= current segment size:
     Number of read and write commands > current segment size:

   (QUANTUM) DAT72*
     Rewrites since last read-type operation:
     Re-reads since last write-type operation:
     Current number of Groups Written:
     Current number of RAW Retries:
     Current number of Groups Read:
     Current number of ECC-3 Retries:
     Previous number of Groups Written:
     Previous number of RAW Retries:
     Previous number of Groups Read:
```

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```
     Previous number of ECC-3 Retries:
     Total number of Groups Written:
     Total number of RAW Retries:
     Total number of Groups Read:
     Total number of ECC-3 Retries:
     Load Count:
     Cassette serial number: (alphanumeric)
     Remaining capacity, partition 0 (kilobytes):
     Remaining capacity, partition 1(kilobytes):
     Maximum capacity , partition 0 (kilobytes):
     Maximum capacity, partition 1 (kilobytes):
     Total SATA link errors (alignment):
     Total SATA link errors (disparity):
     Total SATA link errors (10b/8b code data):
     Total SATA link errors (CRC):
     Total SATA link errors (cont seq:
     Total SATA link errors (threshold):
     Total SATA link errors (eb overflow):
     Total SATA link errors (eb underflow):
     Total SATA link errors (bad comp rcvd):
     Total SATA link errors (bad pio):
     Total SATA link errors (bad FIS type):
     Total SATA link errors (bad FIS size):
     Total SATA link errors (bad data size):
     Total SATA link errors (retry attempted):
     Total SATA link errors (retry successful):
     Total SATA link errors (retry failed):
     Total SATA link errors (tx_req_ack):
     Total SATA link errors (alignment):
     Number of entities written:
     Number of entities read:
     Number of records written:
     Number of records read:
     Kilobytes to data compression:
     Kilobytes from data compression:
     Kilobytes to tape:
     Kilobytes from tape:
     Logical entity size:
     Physical entity size:
     Uncompressed entities:
     Switch setting bitmask:
     Compression set by MS:
     Decompression set by MS:
     Current block size:
     Current partition:
     Prevent(1)/allow(0) media removal:
     Cartridge write protected:
     Report Setmarks:
     Data compression ratio:
     Total groups written:
     Total rewrites:
     Total groups read:
     Total ECC C3 corrections:
     Total rereads:
     Total load count:
     Minutes since last cleaning:
     Power on minutes:
     Cylinder on minutes:
     Cleaning cartridge count:
     Worn tape flag:
     Media DEAD flag:
     Time to clean:

   (Any)
S?D2401*,S?D6401*,S?DL424*,S?DL624*,S?D124*,S?D224*,S?D624*,S?L496*,S?L696*,S?D180*,S?D280*,S?D680*,S?D140*,
S?D240*,S?D640*,S?D120*,S?D220*,S?D620*
     Rewrites since last read-type operation:
     Re-reads since last write-type operation:
     Current number of Groups Written:
     Current number of RAW Retries:
     Current number of Groups Read:
```

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```
  Current number of ECC-3 Retries:
  Previous number of Groups Written:
  Previous number of RAW Retries:
  Previous number of Groups Read:
  Previous number of ECC-3 Retries:
  Total number of Groups Written:
  Total number of RAW Retries:
  Total number of Groups Read:
  Total number of ECC-3 Retries:
  Load Count:
  Remaining capacity, partition 0 (kilobytes):
  Remaining capacity, partition 1(kilobytes):
  Maximum capacity , partition 0 (kilobytes):
  Maximum capacity, partition 1 (kilobytes):

(Any) SIDEWINDER*,S?A150000W*,S?A1701*,S?A250000W*,S?A2701*,S?A4200*,S?A6200*,S?A650000W,S?A6701*
  Current number of Groups Written:
  Current number of RAW Retries:
  Current number of Groups Read:
  Current number of ECC-3 Retries:
  Previous number of Groups Written:
  Previous number of RAW Retries:
  Previous number of Groups Read:
  Previous number of ECC-3 Retries:
  Total number of Groups Written:
  Total number of RAW Retries:
  Total number of Groups Read:
  Total number of ECC-3 Retries:
  Load Count:
  Drum revolution minute:
  Load count:
  Thread count:
  Mechanism motion count (rotary encoder):
  Cleaning interval (minute):
  EEPROM written count:
  MD serial number:
  Drive serial number:
  Number of entities written:
  Number of entities read:
  Number of records written:
  Number of records read:
  Kilobytes to data compression:
  Kilobytes from data compression:
  Kilobytes to tape:
  Kilobytes from tape:
  Logical entity size:
  Physical entity size:
  Uncompressed entities:

(SEAGATE) S?T20000A*,S?T8000A*
  Number of ECC corrections on even tracks:
  Number of ECC corrections on odd tracks:
  Number of read retries on even tracks:
  Number of read retries on odd tracks:
  Remaining capacity, partition 0 (kilobytes):
  Remaining capacity, partition 1(kilobytes):
  Maximum capacity , partition 0 (kilobytes):
  Maximum capacity, partition 1 (kilobytes):

(SEAGATE) ULTRIUM06242*,S?U4200*,S?U6200*,S?UL6200*
  Thread count:
  Total data sets written:
  Total write retries:
  Total unrecovered write retries:
  Total suspended writes:
  Total fatal suspended writes:
  Total data sets read:
  Total read retries:
  Total unrecovered read errors:
  Total suspended append writes:
  Remaining capacity in MB:
```

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```
  Maximum capacity in MB:
  Read compression ratio (percentage - reset on cartridge change):
  Write compression ratio (percentage - reset on cartridge change):
  Number of MB transferred to host:
  Number of bytes less than full MB transferred to host:
  Number of MB read from tape:
  Number of bytes less than full MB read from tape:
  Number of MB transferred from host:
  Number of bytes less than full MB transferred from host:
  Number of MB written to tape:
  Number of bytes less than full MB written to tape:

(SONY) SDX*
  Current number of groups written:
  Current number of raw retries:
  Current number of Groups Read:
  Current number of ECC-3 Retries:
  Previous number of Groups Written:
  Previous number of RAW Retries:
  Previous number of Groups Read:
  Previous number of ECC-3 Retries:
  Total number of Groups Written:
  Total number of RAW Retries:
  Total number of Groups Read:
  Total number of ECC-3 Retries:
  Load Count:
  Remaining capacity, partition 0 (kilobytes):
  Remaining capacity, partition 1(kilobytes):
  Maximum capacity , partition 0 (kilobytes):
  Maximum capacity, partition 1 (kilobytes):
  Remaining capacity, partition 2 (kilobytes):
  Remaining capacity, partition 3(kilobytes):
  Maximum capacity , partition 2 (kilobytes):
  Maximum capacity, partition 3 (kilobytes):
  Drum revolutions per minute:
  Load count:
  Thread count:
  Mechanism motion count (rotary encoder):
  Cleaning interval (minute):
  EEPROM written count:
  MD serial number:
  PCB serial number:
  Drive serial number:
  Frame read errors:
  Main data SYMN block errors on reads - channel 1:
  Main data SYMN block errors on reads - channel 2:
  Total read retry count:
  C2 uncorrectable block on read:
  Frame write errors:
  Main data SYMN block errors on writes - channel 1:
  Main data SYMN block errors on writes - channel 2:
  Number of entities written:
  Number of entities read:
  Number of records written:
  Number of records read:
  Kilobytes to data compression:
  Kilobytes from data compression:
  Kilobytes to tape:
  Kilobytes from tape:
  Logical entity size:
  Physical entity size:
  Uncompressed entities:
  Current number of groups written (partition 0):
  Current RAW retries (partition 0):
  Current number of groups read (partition 0):
  Current C3 ECC retries (partition 0):
  Previous number of group written (partition 0):
  Previous RAW retries (partition 0):
  Previous number of group read (partition 0):
  Previous C3 ECC retries (partition 0):
  Total number of groups written (partition 0):
```

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```
  Total RAW retries (partition 0):
  Total number of groups read (partition 0):
  Total C3 ECC retries (partition 0):
  Load count (partition 0):
  Access count (partition 0):
  Update replace count (partition 0):
  Last valid absolute frame number (partition 0):
  Partition attribute (partition 0):
  Maximum absolute frame number (partition 0):
  Current number of groups written (partition 1):
  Current RAW retries (partition 1):
  Current number of groups read (partition 1):
  Current C3 ECC retries (partition 1):
  Previous number of group written (partition 1):
  Previous RAW retries (partition 1):
  Previous number of group read (partition 1):
  Previous C3 ECC retries (partition 1):
  Total number of groups written (partition 1):
  Total RAW retries (partition 1):
  Total number of groups read (partition 1):
  Total C3 ECC retries (partition 1):
  Load count (partition 1):
  Access count (partition 1):
  Update replace count (partition 1):
  Last valid absolute frame number (partition 1):
  Partition attribute (partition 1):
  Maximum absolute frame number (partition 1):
  MIC Logical format type:
  User volume note size:
  Cassette serial number: (alphanumeric)
  Cassette Manufacturer ID: (alphanumeric)
  User partition note size (partition 0):
  User partition note size (partition 1):

(SONY) SDT*,TSL*
  Current number of groups written:
  Current number of raw retries:
  Current number of Groups Read:
  Current number of ECC-3 Retries:
  Previous number of Groups Written:
  Previous number of RAW Retries:
  Previous number of Groups Read:
  Previous number of ECC-3 Retries:
  Total number of Groups Written:
  Total number of RAW Retries:
  Total number of Groups Read:
  Total number of ECC-3 Retries:
  Load Count:
  Remaining capacity, partition 0 (kilobytes):
  Remaining capacity, partition 1(kilobytes):
  Maximum capacity , partition 0 (kilobytes):
  Maximum capacity, partition 1 (kilobytes):
  Drum revolutions per minute:
  Load count:
  Thread count:
  Mechanism motion count (rotary encoder):
  Cleaning interval (minute):
  EEPROM written count:
  MD serial number:
  PCB serial number:
  Drive serial number:
  Number of entities written:
  Number of entities read:
  Number of records written:
  Number of records read:
  Kilobytes to data compression:
  Kilobytes from data compression:
  Kilobytes to tape:
  Kilobytes from tape:
  Logical entity size:
  Physical entity size:
```

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```
     Uncompressed entities:

   (STK) 98*,T9*,T8*
     Number of records with a recovered data check while reading:
     Number of records with a recovered data check while writing:
     Number of read temporary errors detected by software:
     Number of write temporary errors detected by software:
     Number of times a read record was retried before recovery passed or failed:
     Number of servo position units (24 mm) used up by defects:
     Number of times read blocks were recovered after one retry (read transients):
     Number of times write blocks were recovered after one retry (write transients):
     Adjusted read corrections:
     Number of blocks read from tape hardware corrected:
     Adjusted write corrections:
     Number of blocks written on tape hardware corrected:
     Number of errors detected by the controller when transferring data between the controller and interface
adapter:
     Number of servo temporary off track errors:

   (TANDBERG) SLR*
     Total logical data blocks transferred:
     Total physical blocks written to media:
     Total physical blocks read from media (Read and Space operations only):
     Approx remaining capacity of partition 0 (in KBytes):
     Approx remaining capacity of current partition (in KBytes):
     Approx maximum capacity of partition 0 (in KBytes):
     Approx maximum capacity of current partition (in KBytes):
     Number of file marks:
     Number of set marks:
     Number of minutes of motion since last head cleaning:
     Number of head cleanings:
     Total power-on minutes:
     Total number of cartridge loads:
     Number of servo lock retries:
     Number of servo track seeks:
     Number of lost servo locks on writes:
     Number of write servo dropouts:
     Number of lost servo locks on reads:
     Number of read servo dropouts:
     Current selected track number:
     Cartridge serial number: (alphanumeric)
     Number of times this cartridge loaded:
     Number of beginning-of-tape markers passed for this tape:
     Number of end-of-tape markers passed for this tape:
     Number of cartridge write past counters:
     Number of minutes cartridge has been in motion:
     Write compression ratio (percentage - reset on cartridge change):
     Read compression ratio (percentage - reset on cartridge change):
     Percentage of data with compression between .89 and 1.2 - reset on cartridge change:
     Percentage of data with compression between 1.2 and 1.6 - reset on cartridge change:
     Percentage of data with compression between 1.6 and 2.2 - reset on cartridge change:
     Percentage of data with compression between 2.2 and 3.6 - reset on cartridge change:
     Percentage of data with compression greater than 3.6 - reset on cartridge change:

   (TANDBERG) SDLT320*,SDLT330*
     Read compression ratio (percentage - reset on cartridge change):
     Write compression ratio (percentage - reset on cartridge change):
     Number of MB transferred to host:
     Number of bytes less than full MB transferred to host:
     Number of MB read from tape:
     Number of bytes less than full MB read from tape:
     Number of MB transferred from host:
     Number of bytes less than full MB transferred from host:
     Number of MB written to tape:
     Number of bytes less than full MB written to tape:
     Number of loads over lifetime of the tape drive:
     Number of cleaning sessions per cartridge:
     Drive temperature in degrees C:

 Vendor-specific (SCSI Inquiry) information: (All numeric unless otherwise marked)
   (IBM) IC35*
```

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```
Unit Serial Number (alphanumeric)
IEEE Unique ID (IEEE)

(IBM) DFHS*
Product type (alphanumeric)
Model number (alphanumeric)
ROM code Revision Level (alphanumeric)
RAM Load Revision Level (alphanumeric)
Unit Serial Number (alphanumeric)
Made by (alphanumeric)
RAM uCode Load P/N (alphanumeric)
ROM uCode Load P/N (alphanumeric)
Servo P/N (alphanumeric)
Load ID (hex)
Releaselevel/modification numbr (hex)
Assembly P/N-0 (alphanumeric)
Assembly P/N-1 (alphanumeric)
Assembly EC-0 (alphanumeric)
Assembly EC-1 (alphanumeric)
Card Assembly P/N-0 (alphanumeric)
Card Assembly P/N-1 (alphanumeric)
Card Assembly EC-0 (alphanumeric)
Card Assembly EC-2 (alphanumeric)

(IBM) DGHC*
ASCII Assembly EC (alphanumeric)
Load ID (hex)
Release level/modification number (hex)
PTF Number
Patch Number
ASCII microcode identifier (alphanumeric)
Servo P/N (hex)
Product identifier (page 82, 8 bytes) (alphanumeric)
Page C7, offset 0dh Flags (binary)
Microcode download size (bytes) (hex)
Minutes between spin up/down (hex)
Microcode dataset name for device (alphanumeric)
Media disk definition (alphanumeric)
Motor serial number (alphanumeric)
Flex assembly serial number (alphanumeric)
Actuator serial number (alphanumeric)
Device enclosure serial number (alphanumeric)

(IBM) DGHS*,DGVS*
ASCII Assembly EC (alphanumeric)
Load ID (hex)
Release level/modification number (hex)
PTF Number
Patch Number
ASCII microcode identifier (alphanumeric)
Servo P/N (hex)
Product identifier (page 82, 8 bytes) (alphanumeric)
Media disk definition (alphanumeric)
Motor serial number (alphanumeric)
Flex assembly serial number (alphanumeric)
Actuator serial number (alphanumeric)
Device enclosure serial number (alphanumeric)
Card serial number (alphanumeric)
Card assembly part number (alphanumeric)

(IBM) DMV*
ASCII Assembly P/N (alphanumeric)
ASCII Assembly EC (alphanumeric)
Load ID (hex)
Release level/modification number (hex)
PTF Number
Patch Number
ASCII microcode identifier (alphanumeric)
Servo P/N (hex)
Product identifier (page 82, 8 bytes) (alphanumeric)
Media disk definition (alphanumeric)
```

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```
Motor serial number (alphanumeric)
Flex assembly serial number (alphanumeric)
Actuator serial number (alphanumeric)
Device enclosure serial number (alphanumeric)
Card serial number (alphanumeric)
Card assembly part number (alphanumeric)

(MAXTOR) ATLAS 10KIII*
SCSI Hardware Revision #
Disk Controller Revision #
Electronics Pass Number
HDA serial number (alphanumeric)
Operating definition (alphanumeric)
Full firmware version (alphanumeric)
Firmware build date/time (date)
Quantum unique identification (Page C1h) (hex)

(QUANTUM) ATLAS IV*
Electronic serial number (hex)
HDA serial number (alphanumeric)
Operating definition (alphanumeric)
Full firmware version (alphanumeric)
Firmware build date/time (date)
Quantum unique identification (Page C1h) (alphanumeric)

(QUANTUM) ATLAS V*
HDA serial number (alphanumeric)
Operating definition (alphanumeric)
Full firmware version (alphanumeric)
Firmware build date/time (date)
Quantum unique identification (Page C1h) (hex)

(QUANTUM) ATLAS 10K-*
SCSI Hardware Revision #
Disk Controller Revision #
Electronics Pass Number
HDA serial number (alphanumeric)
Operating definition (alphanumeric)
Full firmware version (alphanumeric)
Firmware build date/time (date)
Quantum unique identification (Page C1h) (hex)

(QUANTUM) ATLAS 10KII-*
SCSI Hardware Revision #
Disk Controller Revision #
Electronics Pass Number
HDA serial number (alphanumeric)
Operating definition (alphanumeric)
Full firmware version (alphanumeric)
Firmware build date/time (date)
Quantum unique identification (Page C1h) (hex)
Negotiated rate information (Page C2h) (hex)

(SEAGATE) (all FC disks)
Board serial number (alphanumeric)
IEEE Unique ID (IEEE)
Servo RAM Release number (alphanumeric)
Servo ROM Release number (alphanumeric)
Servo RAM Release date (date)
Servo ROM Release date (date)
Product date code MMDDYYYY (date)
Compile date code MMDDYYYY (date)
Jumpers S2 S1 - - - - - - (binary)
Select-ID (See manual for AL_PA) (hex)
Drive behavior version number
Drive behavior code
Drive behavior code version
Model number (alphanumeric)
Maximum interleave
Default # of cache segments
```

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```
   (*)
BC036122C3,ST330007L*,ST3146707L*,ST373207L*,ST336706L*,ST118202*,ST118273*,ST11900*,ST11950*,ST12400*,ST124
50*,ST12550*,ST136403*,ST136475*,ST15150*,ST150176*,ST15230*,ST18771*,ST19101*,ST19171*,ST31051*,ST31055*,ST
31200*,ST31230*,ST31231*,ST31250*,ST318203*,ST32272*,ST32151*,ST32155*,ST32171*,ST32550*,ST32430*,ST3285*,ST
3390*,ST34371*,ST34501*,ST34502*,ST34572*,ST34573*,ST3655*,ST39102*,ST39103*,ST39173*,ST410800*,ST423451*,ST
52160*
   Board serial number (alphanumeric)
   Servo RAM Release number (alphanumeric)
   Servo ROM Release number (alphanumeric)
   Servo RAM Release date (date)
   Servo ROM Release date (date)
   ETF Log date MMDDYYYY (date)
   Compile date code MMDDYYYY (date)
   Jumpers DS MS WP PE D0 D1 D2 D3 (binary)
   Drive behavior version number
   Drive behavior code
   Drive behavior code version
   Family number (alphanumeric)
   Maximum interleave
   Default # of cache segments

   (TANDBERG) SLR7
   Capstan motor assembly rev (alphanumeric)
   Step motor assembly rev (alphanumeric)
   Cartridge manipulation motor rev (alphanumeric)
   Sensor assembly rev (alphanumeric)
   Mainboard assembly rev (alphanumeric)
   Frame module rev (alphanumeric)
   Head assembly rev (alphanumeric)
   Top cover rev (alphanumeric)
   Bridge module rev (alphanumeric)
   Main spring module rev (alphanumeric)
   Main microcode rev (alphanumeric)
   Main microcode release status (alphanumeric)
   Main microcode branch rev (alphanumeric)
   Main microcode ID (alphanumeric)
   DSP microcode rev level (alphanumeric)
   DSP microcode release status (alphanumeric)
   Drive manufacturing MM.DD.YY (alphanumeric)
   Main microcode creation MM.DD.YY (alphanumeric)
   DSP microcode creation MM.DD.YY (alphanumeric)
   Last drive adjustment MM.DD.YY (alphanumeric)

   (HP) HP35470*,HP35480*,C1533*,C1534*,C1536*,C1537*,C1539*,C1553*,C1557*,C5683A*,C5713A*
   CD-ROM Emulation string (alphanumeric)
   Firmware revision (alphanumeric)
   Firmware build date (date)
   Product identification (alphanumeric)

   (LSI) SAS Enclosure
   Max expander speed (alphanumeric)
   Tray Descriptor (alphanumeric)
   Backplane FRU P/N (alphanumeric)
   System serial number (alphanumeric)
   FRU vendor (alphanumeric)
   FRU manufacture date (date)
   FRU type (alphanumeric)
   ESM P/N (alphanumeric)
   ESM serial number (alphanumeric)
   ESM vendor (alphanumeric)
   ESM manufacture date (date)
   ESM type (alphanumeric)
   PSU(0) P/N (alphanumeric)
   PSU(0) serial number (alphanumeric)
   PSU(0) vendor (alphanumeric)
   PSU(0) manufacture date (date)
   PSU(0) type (alphanumeric)
   PSU(1) P/N (alphanumeric)
   PSU(1) serial number (alphanumeric)
   PSU(1) vendor (alphanumeric)
   PSU(1) manufacture date (date)
```

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```
   PSU(1) type (alphanumeric)

   (NEWISYS) NDS2240
   Max expander speed (alphanumeric)
   Tray Descriptor (alphanumeric)
   Backplane FRU P/N (alphanumeric)
   System serial number (alphanumeric)
   FRU vendor (alphanumeric)
   FRU manufacture date (date)
   FRU type (alphanumeric)
   ESM P/N (alphanumeric)
   ESM serial number (alphanumeric)
   ESM vendor (alphanumeric)
   ESM manufacture date (date)
   ESM type (alphanumeric)
   PSU(0) P/N (alphanumeric)
   PSU(0) serial number (alphanumeric)
   PSU(0) vendor (alphanumeric)
   PSU(0) manufacture date (date)
   PSU(0) type (alphanumeric)
   PSU(1) P/N (alphanumeric)
   PSU(1) serial number (alphanumeric)
   PSU(1) vendor (alphanumeric)
   PSU(1) manufacture date (date)
   PSU(1) type (alphanumeric)

   Total Vendor-specific log page records: 1707
   Total Vendor-specific inq page records: 203
   Total ANSI-defined log page records: 55
   Total TapeAlert messages:  52
```

If your device does not appear above, remember that there are still dozens of other ANSI-standard fields that will be reported. Please feel free to contact us, so that we may work with your device's manufacturer in order to obtain the necessary programming information required to add vendor-unique reporting for it.

1.50 Write Cache Enable

The **-wce** command was added to facilitate one of the most common mode page changes. This enables the write cache on the disk drive. (The command is generally not applicable to anything but disk drives. However, you could theoretically have a device that is not a disk drive that uses a write cache). Conversely, use the **-wcd** command to disable the write cache.

(The write cache bit is located on mode page #8, byte #2, bit #2. If that bit is set, the cache is enabled. Note that only one byte is different in the commands below.

Example(s)

```
[root@BOSS etc]# ./smartmon-ux -wce /dev/sg2
SMARTMon-ux [Release 1.28, Build 01-APR-2005] - Copyright 2001-2005 SANtools, Inc. http://www.SANtools.com
Discovered SEAGATE ST373307LC S/N "3HZ03822" on /dev/sg2 (SMART enabled)(70007 MB)
  Sending command:  -B S,08,12,14,00,FF,FF,00,00,FF,FF,FF,FF,00,20,00,00,00,00,00,00
          Result: (SUCCESS) - The write cache is now enabled


Program Ended.

[root@BOSS etc]# ./smartmon-ux -wcd /dev/sg2
SMARTMon-ux [Release 1.28, Build 01-APR-2005] - Copyright 2001-2005 SANtools, Inc. http://www.SANtools.com
Discovered SEAGATE ST373307LC S/N "3HZ03822" on /dev/sg2 (SMART enabled)(70007 MB)
  Sending command:  -B S,08,12,10,00,FF,FF,00,00,FF,FF,FF,FF,00,20,00,00,00,00,00,00
          Result: (SUCCESS) - The write cache is now disabled


Program Ended.

[root@BOSS etc]# ./smartmon-ux -wcd /dev/sg2
```

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```
SMARTMon-ux [Release 1.28, Build 01-APR-2005] - Copyright 2001-2005 SANtools, Inc. http://www.SANtools.com
Discovered SEAGATE ST373307LC S/N "3HZ03822" on /dev/sg2 (SMART enabled)(70007 MB)
  Sending command:  -B S,08,12,10,00,FF,FF,00,00,FF,FF,FF,FF,00,20,00,00,00,00,00,00
          Result: (SUCCESS) - The write cache was already disabled.

Program Ended.
```

Finally, a warning .. the write cache is typically disabled for a reason. When the cache is disabled, the disk does not return a complete code to the host until the disk has physically recorded the block(s). When write cache is enabled, the disk immediately responds to the host telling it the I/O has been completed. This can significantly improve write performance.

You have a risk in that when you use a write cache, a power loss will result in permanent data loss of any writes that have occurred between the time the disk last flushed the pending writes to the disk drive and the power failure. The amount of time it takes between flushing is typically a few seconds, but this value is vendor/product/device specific.

You may also use the mode page editor to control the write cache. The **-wce** was introduced because enabling / disabling the write cache is a common activity performed by system administrators.

1.51 Write Protected Media Test

This feature was added in release 1.28. It provides a convenient test to see if the media in a device (typically a tape drive) is write protected.
Note, some operating systems, such as HP/UX do not support querying tape drives unless there is media inserted into them.

Syntax

-wp {devicefile}.

Example:

```
# ./smartmon-ux -wp
SMARTMon-ux [Release 1.27T-1, Build 12-APR-2005] - Copyright 2001-2005 SANtools, Inc.
http://www.SANtools.com
Discovered MITSUMI CD-ROM FX4830T!B S/N " " on /dev/rdsk/c0t0d0 (CD/DVD)
Discovered IBM DDRS-39130LC S/N "RE371797" on /dev/rdsk/c2t5d0 (SMART enabled)(8678 MB)
Discovered IBM DDRS-39130LC S/N "RE371728" on /dev/rdsk/c2t6d0 (SMART enabled)(8678 MB)
Discovered HP C1533A S/N " " on /dev/rmt/0mn (Media WRITE-PROTECTED)
Program Ended.
```

The test above was run without any device options on a HP/UX machine. It scanned for all devices and reported that the C1533A tape had write-protected media. The test below was run on the same machine, but we used wild-cards for various device names that are associated with that tape.

```
# ./smartmon-ux -wp /dev/rmt/0m*
SMARTMon-ux [Release 1.27T-1, Build 12-APR-2005] - Copyright 2001-2005 SANtools, Inc.
http://www.SANtools.com
*****************************************************************
* F o r U N I S Y S A U C K L A N D E v a l u a t i o n *
* This software will expire on *
* 05/05/05 (22 days remaining). *
*****************************************************************
Discovered HP C1533A S/N " " on /dev/rmt/0m (Media WRITE-PROTECTED)
Discovered HP C1533A S/N " " on /dev/rmt/0mb (Media WRITE-PROTECTED)
Discovered HP C1533A S/N " " on /dev/rmt/0mn (Media WRITE-PROTECTED)
Discovered HP C1533A S/N " " on /dev/rmt/0mnb (Media WRITE-PROTECTED)
Program Ended.
```

We then slid over the write protect tab ...

```
# ./smartmon-ux -wp /dev/rmt/0*
SMARTMon-ux [Release 1.27T-1, Build 12-APR-2005] - Copyright 2001-2005 SANtools, Inc.
http://www.SANtools.com
*****************************************************************
```

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```
* F o r U N I S Y S A U C K L A N D E v a l u a t i o n *
* This software will expire on *
* 05/05/05 (22 days remaining). *
*****************************************************************
Discovered HP C1533A S/N " " on /dev/rmt/0m (Media Read/Write)
Discovered HP C1533A S/N " " on /dev/rmt/0mb (Media Read/Write)
Discovered HP C1533A S/N " " on /dev/rmt/0mn (Media Read/Write)
Discovered HP C1533A S/N " " on /dev/rmt/0mnb (Media Read/Write)
Program Ended.
```

Feature Notes:

- This function is not applicable to ATA/SATA disk drives.

1.52 RAID Engine Support

1.52.1 LSI (Mylex) RAID Engines

If you are using an external fibre channel RAID subsystem that incorporates a Mylex family engine, the software can provide details on the health of the devices as well as return event log entries that are maintained by the RAID controller. The supported engines are members of the DAC960 family and include models FF, FF2, FFx, and FFx2. These engines are also known as the SANArray Pro family. You must be running 7.0 firmware or higher.

If you are not sure what RAID engine you are using, you should ask your RAID vendor or try sending one of the -Z options to a logical disk in the RAID subsystem and see if you get any results.

When you supply any of the **-Z** command line options, you instruct SMARTMon-UX to send Mylex vendor-specific commands to query the RAID engine and report the desired information. If you send them to a non-Mylex controller, the commands will be rejected by the device and no RAID information will be returned. All of the commands can be sent at any time to the RAID engine and are non-destructive (see notes on the **-ZL**, **-ZA** and **-ZM** options). If you are running extremely heavy I/O, it may take several minutes for these options to complete.

Command Options

The -Z option (note the case. -Z is for LSI/Mylex family, while -z is for LSI/Engenio family) displays a summary of all of the physical disks installed in the subsystem that are known to the RAID controller. In addition it will display information on all of the logical devices which are defined.

```
smartmon-ux -Z \\.\PHYSICALDRIVE5
SMARTMon-ux [Release 1.16, Build 27-DEC-2002] - Copyright 2002 SANtools, Inc. http://www.SANtools.com
Discovered MYLEX DACARMRB247240T5 S/N " " on \\.\PHYSICALDRIVE5 (SMART unsupported)
[Adapter/ID.LUN=4/3.31](247239 MB)
 This is a RAID Controller model "DAC960FFx" with 128 MB of RAM running firmware revision 7.70.
  Physical Device Dump:
   SEAGATE ST336605FC [0004] S/N=3FP00B1P 20:00:00:20:37:e6:0f:48 71132960 Blocks at 0:05h [ONLINE]
   SEAGATE ST336605FC [0004] S/N=3FP017BV 20:00:00:20:37:e6:95:b7 71687371 Blocks at 0:07h [ONLINE]
   SEAGATE ST336605FC [0003] S/N=3FP00BB7 20:00:00:20:37:e6:0a:38 71132960 Blocks at 0:09h [ONLINE]
   SEAGATE ST336605FC [0003] S/N=3FP00ARC 20:00:00:20:37:e6:0b:ef 71132960 Blocks at 0:0Bh [HOTSPARE]
   SEAGATE ST336605FC [0003] S/N=3FP017K6 20:00:00:20:37:e6:95:a5 71687371 Blocks at 0:0Dh [ONLINE]
   SEAGATE ST336605FC [0003] S/N=3FP00BJZ 20:00:00:20:37:e6:09:3a 71132960 Blocks at 0:0Fh [ONLINE]
   SEAGATE ST336605FC [0003] S/N=3FP0148W 20:00:00:20:37:e6:95:1a 71687371 Blocks at 0:11h [ONLINE]
   SEAGATE ST336605FC [0003] S/N=3FP011LD 20:00:00:20:37:e6:93:b2 71687371 Blocks at 0:13h [ONLINE]
   SEAGATE ST336605FC [0003] S/N=3FP009Z6 20:00:00:20:37:e6:06:31 71132960 Blocks at 1:04h [ONLINE]
   SEAGATE ST336605FC [0003] S/N=3FP008NA 20:00:00:20:37:e6:03:c3 71132960 Blocks at 1:06h [ONLINE]
   SEAGATE ST336605FC [0003] S/N=3FP009Y0 20:00:00:20:37:e6:0c:84 71132960 Blocks at 1:08h [ONLINE]
   SEAGATE ST336605FC [0003] S/N=3FP008FD 20:00:00:20:37:e6:03:80 71132960 Blocks at 1:0Ah [ONLINE]
   SEAGATE ST336605FC [0003] S/N=3FP00B4W 20:00:00:20:37:e6:09:be 71132960 Blocks at 1:0Ch [ONLINE]
   SEAGATE ST336605FC [0003] S/N=3FP00ANW 20:00:00:20:37:e6:07:3d 71132960 Blocks at 1:0Eh [ONLINE]
   SEAGATE ST336605FC [0004] S/N=3FP00B01 20:00:00:20:37:e6:08:7d 71132960 Blocks at 1:10h [ONLINE]
   SEAGATE ST336605FC [0004] S/N=3FP00Y3T 20:00:00:20:37:e6:9f:53 71687371 Blocks at 1:12h [ONLINE]
  RAID Controller Logical Device Dump:
   LUN[0] State=Optimal RAID_5 DeviceSize=20500480 Blocks
   LUN[1] State=Optimal RAID_5 DeviceSize=40972288 Blocks
   LUN[2] State=Optimal RAID_5 DeviceSize=102416384 Blocks
```

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```
   LUN[3] State=Optimal RAID_5 DeviceSize=40972288 Blocks
   LUN[4] State=Optimal RAID_5 DeviceSize=40972288 Blocks
   LUN[5] State=Optimal RAID_0 DeviceSize=40980480 Blocks
   LUN[6] State=Optimal RAID_5 DeviceSize=122888192 Blocks
   LUN[7] State=Optimal RAID_5 DeviceSize=81944576 Blocks
   LUN[8] State=Optimal RAID_5 DeviceSize=506347520 Blocks
Terminating program.
```

In the example above, you can see the FFx RAID engine is running 7.70 firmware and has 128MB of RAM. It is attached to 16 Seagate disk drives. The first disk is a ST336605FC running firmware release 0004, and the serial numbers and world-wide names are also displayed. There are 71132960 usable blocks, and it is configured for channel 0 at hex ID #5. State is ONLINE. The subsystem also defines a single disk as a hot spare.

There are 9 logical devices, all of which are defined as RAID5 except for a single striped RAID0 LUN. All logical devices are "Optimal" which means they are online and operating properly. If you had a drive failure, you might see status of Critical, Rebuilding, or Off line.

In the example below, we instructed the engine to return all known events in the controller's internal event log. The Mylex event log maintains the last 512 events and is volatile. That is, the log starts at event #0 at system power up time. Power cycles reset the log. Our example shows the power-on sequence for a controller through an exercise where we turned off each of the redundant power supplies to generate some events.

```
smartmon-ux -ZL \\.\PHYSICALDRIVE5
SMARTMon-ux [Release 1.16, Build 27-DEC-2002] - Copyright 2002 SANtools, Inc. http://www.SANtools.com
Discovered MYLEX DACARMRB247240T5 S/N " " on \\.\PHYSICALDRIVE5 (SMART unsupported)
[Adapter/ID.LUN=4/3.31](247239 MB)
  Event log (Max of 512 events saved in controller):
   (0) [Severe] Ch:ID=0:0 "WARM BOOT failed. Memory error detected during WARM boot scan. Possible data
loss."
   (1) [Warning] Ctl=0 "Dual controllers enabled."
   (2) [Info]  "Array management server software started successfully. The server system (or array
management utility server) started."
   (3) [Info] Ctl=0 "Parameter type value is the reboot count. Automatic reboot count has changed.
Controller has rebooted. Automatic reboot has rearmed itself or was reconfigured."
   (4) [Warning] Ctl=0 "Updated partner's status."
   (5) [Warning] Ctl=0 "Dual controllers entered nexus."
   (6) [Warning] Ctl=0 "Updated partner's status."
   (7) [Warning] Ctl=0 "Dual controllers enabled."
   (8) [Info]  "Array management server software started successfully. The server system (or array
management utility server) started."
   (9) [Info] Ctl=0 "Parameter type value is the reboot count. Automatic reboot count has changed.
Controller has rebooted. Automatic reboot has rearmed itself or was reconfigured."
   (10) [Warning] Ctl=0 "Updated partner's status."
   (11) [Warning] Ctl=0 "Updated partner's status."
   (12) [Info] Ch:ID=1:4 "A new hard disk has been found. A physical device has been powered on. A new
physical device has been added. Controller was powered on. Controller was added. System has rebooted."
   (13) [Info] Ch:ID=0:5 "A new hard disk has been found. A physical device has been powered on. A new
physical device has been added. Controller was powered on. Controller was added. System has rebooted."
   (14) [Info] Ch:ID=1:6 "A new hard disk has been found. A physical device has been powered on. A new
physical device has been added. Controller was powered on. Controller was added. System has rebooted."
   (15) [Info] Ch:ID=0:7 "A new hard disk has been found. A physical device has been powered on. A new
physical device has been added. Controller was powered on. Controller was added. System has rebooted."
   (16) [Info] Ch:ID=1:8 "A new hard disk has been found. A physical device has been powered on. A new
physical device has been added. Controller was powered on. Controller was added. System has rebooted."
   (17) [Info] Ch:ID=0:9 "A new hard disk has been found. A physical device has been powered on. A new
physical device has been added. Controller was powered on. Controller was added. System has rebooted."
   (18) [Info] Ch:ID=1:10 "A new hard disk has been found. A physical device has been powered on. A new
physical device has been added. Controller was powered on. Controller was added. System has rebooted."
   (19) [Info] Ch:ID=0:11 "A new hard disk has been found. A physical device has been powered on. A new
physical device has been added. Controller was powered on. Controller was added. System has rebooted."
   (20) [Info] Ch:ID=1:12 "A new hard disk has been found. A physical device has been powered on. A new
physical device has been added. Controller was powered on. Controller was added. System has rebooted."
   (21) [Info] Ch:ID=0:13 "A new hard disk has been found. A physical device has been powered on. A new
physical device has been added. Controller was powered on. Controller was added. System has rebooted."
   (22) [Info] Ch:ID=1:14 "A new hard disk has been found. A physical device has been powered on. A new
physical device has been added. Controller was powered on. Controller was added. System has rebooted."
   (23) [Info] Ch:ID=0:15 "A new hard disk has been found. A physical device has been powered on. A new
physical device has been added. Controller was powered on. Controller was added. System has rebooted."
   (24) [Info] Ch:ID=1:16 "A new hard disk has been found. A physical device has been powered on. A new
```

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```
physical device has been added. Controller was powered on. Controller was added. System has rebooted."
   (25) [Info] Ch:ID=0:17 "A new hard disk has been found. A physical device has been powered on. A new
physical device has been added. Controller was powered on. Controller was added. System has rebooted."
   (26) [Info] Ch:ID=1:18 "A new hard disk has been found. A physical device has been powered on. A new
physical device has been added. Controller was powered on. Controller was added. System has rebooted."
   (27) [Info] Ch:ID=0:19 "A new hard disk has been found. A physical device has been powered on. A new
physical device has been added. Controller was powered on. Controller was added. System has rebooted."
   (28) [Info] Ctl=0 "Controller device start complete."
   (29) [Info] Ch:ID=1:4 "A new hard disk has been found. A physical device has been powered on. A new
physical device has been added. Controller was powered on. Controller was added. System has rebooted."
   (30) [Info] Ch:ID=0:5 "A new hard disk has been found. A physical device has been powered on. A new
physical device has been added. Controller was powered on. Controller was added. System has rebooted."
   (31) [Info] Ch:ID=1:6 "A new hard disk has been found. A physical device has been powered on. A new
physical device has been added. Controller was powered on. Controller was added. System has rebooted."
   (32) [Info] Ch:ID=0:7 "A new hard disk has been found. A physical device has been powered on. A new
physical device has been added. Controller was powered on. Controller was added. System has rebooted."
   (33) [Info] Ch:ID=1:8 "A new hard disk has been found. A physical device has been powered on. A new
physical device has been added. Controller was powered on. Controller was added. System has rebooted."
   (34) [Info] Ch:ID=0:9 "A new hard disk has been found. A physical device has been powered on. A new
physical device has been added. Controller was powered on. Controller was added. System has rebooted."
   (35) [Info] Ch:ID=1:10 "A new hard disk has been found. A physical device has been powered on. A new
physical device has been added. Controller was powered on. Controller was added. System has rebooted."
   (36) [Info] Ch:ID=0:11 "A new hard disk has been found. A physical device has been powered on. A new
physical device has been added. Controller was powered on. Controller was added. System has rebooted."
   (37) [Info] Ch:ID=1:12 "A new hard disk has been found. A physical device has been powered on. A new
physical device has been added. Controller was powered on. Controller was added. System has rebooted."
   (38) [Info] Ch:ID=0:13 "A new hard disk has been found. A physical device has been powered on. A new
physical device has been added. Controller was powered on. Controller was added. System has rebooted."
   (39) [Info] Ch:ID=1:14 "A new hard disk has been found. A physical device has been powered on. A new
physical device has been added. Controller was powered on. Controller was added. System has rebooted."
   (40) [Info] Ch:ID=0:15 "A new hard disk has been found. A physical device has been powered on. A new
physical device has been added. Controller was powered on. Controller was added. System has rebooted."
   (41) [Info] Ch:ID=1:16 "A new hard disk has been found. A physical device has been powered on. A new
physical device has been added. Controller was powered on. Controller was added. System has rebooted."
   (42) [Info] Ch:ID=0:17 "A new hard disk has been found. A physical device has been powered on. A new
physical device has been added. Controller was powered on. Controller was added. System has rebooted."
   (43) [Info] Ch:ID=1:18 "A new hard disk has been found. A physical device has been powered on. A new
physical device has been added. Controller was powered on. Controller was added. System has rebooted."
   (44) [Info] Ch:ID=0:19 "A new hard disk has been found. A physical device has been powered on. A new
physical device has been added. Controller was powered on. Controller was added. System has rebooted."
   (45) [Info] Ctl=0 "Controller device start complete."
   (46) 14:14:15 12/19/2002 [Info] Ctl:LD=0:0 "Logical drive has been placed online. Rebuild completed. User
set the physical device online. New configuration was added."
   (47) 14:14:15 12/19/2002 [Info] Ctl:LD=0:1 "Logical drive has been placed online. Rebuild completed. User
set the physical device online. New configuration was added."
   (48) 14:14:15 12/19/2002 [Info] Ctl:LD=0:2 "Logical drive has been placed online. Rebuild completed. User
set the physical device online. New configuration was added."
   (49) 14:14:15 12/19/2002 [Info] Ctl:LD=0:3 "Logical drive has been placed online. Rebuild completed. User
set the physical device online. New configuration was added."
   (50) 14:14:15 12/19/2002 [Info] Ctl:LD=0:4 "Logical drive has been placed online. Rebuild completed. User
set the physical device online. New configuration was added."
   (51) 14:14:15 12/19/2002 [Info] Ctl:LD=0:5 "Logical drive has been placed online. Rebuild completed. User
set the physical device online. New configuration was added."
   (52) 14:14:15 12/19/2002 [Info] Ctl:LD=0:6 "Logical drive has been placed online. Rebuild completed. User
set the physical device online. New configuration was added."
   (53) 14:14:15 12/19/2002 [Info] Ctl:LD=0:7 "Logical drive has been placed online. Rebuild completed. User
set the physical device online. New configuration was added."
   (54) 14:14:15 12/19/2002 [Info] Ctl:LD=0:8 "Logical drive has been placed online. Rebuild completed. User
set the physical device online. New configuration was added."
   (55) 14:14:23 12/19/2002 [Info] Ctl=0 "BBU Present. Controller is dead. Controller has been removed.
Controller has been powered off."
   (56) 14:14:26 12/19/2002 [Info] Ctl=0 "BBU Present. Controller is dead. Controller has been removed.
Controller has been powered off."
   (57) 14:14:31 12/19/2002 [Severe] Ctl=0 "BBU recondition needed."
   (58) 14:14:31 12/19/2002 [Info] Ctl:Enc=0:0 "Enclosure services ready."
   (59) 15:27:11 12/19/2002 [Info] Ctl=0 "BBU Power OK. BBU has enough power to enable the write data
cache."
   (60) 15:27:13 12/19/2002 [Warning] Ctl=0 "Controller entered normal cache mode."
   (61) 17:00:18 12/19/2002 [Info] Ctl=0 "BBU Power OK. BBU has enough power to enable the write data
cache."
   (62) 17:00:21 12/19/2002 [Warning] Ctl=0 "Controller entered normal cache mode."
```

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```
   (63) 14:13:57 12/20/2002 [Info] Ctl=0 "Parameter type value is the reboot count. Automatic reboot count
has changed. Controller has rebooted. Automatic reboot has rearmed itself or was reconfigured."
   (64) 14:13:57 12/20/2002 [Info] Ctl=0 "Parameter type value is the reboot count. Automatic reboot count
has changed. Controller has rebooted. Automatic reboot has rearmed itself or was reconfigured."
   (65) 09:34:37 12/22/2002 [Warning] Ctl=0 "UPS Battery Low - Controller entered Conservative Cache Mode."
   (66) 09:34:40 12/22/2002 [Severe] Enc:Unit=1:0 "Power supply failure. Cable connection is broken.  Bad
power supply."
   (67) 09:34:40 12/22/2002 [Warning] Ctl=0 "UPS Battery Low - Controller entered Conservative Cache Mode."
   (68) 09:37:17 12/22/2002 [Warning] Ctl=0 "Controller entered normal cache mode."
   (69) 09:37:19 12/22/2002 [Info] Enc:Unit=1:0 "Power supply has been restored. Faulty power supply has
been replaced."
   (70) 09:37:21 12/22/2002 [Warning] Ctl=0 "Controller entered normal cache mode."
   (71) 09:37:27 12/22/2002 [Warning] Ctl=0 "UPS Battery Low - Controller entered Conservative Cache Mode."
   (72) 09:37:30 12/22/2002 [Severe] Enc:Unit=1:1 "Power supply failure. Cable connection is broken.  Bad
power supply."
   (73) 09:37:30 12/22/2002 [Warning] Ctl=0 "UPS Battery Low - Controller entered Conservative Cache Mode."
   (74) 09:42:25 12/22/2002 [Warning] Ctl=0 "Controller entered normal cache mode."
   (75) 09:42:27 12/22/2002 [Info] Enc:Unit=1:1 "Power supply has been restored. Faulty power supply has
been replaced."
   (76) 09:42:29 12/22/2002 [Warning] Ctl=0 "Controller entered normal cache mode."
Terminating program.
```

Note that the software has entries up through and including firmware release 9.0, which totals to more than 250 events. If you do not understand what any of these events mean, or what you should do about them, please contact your disk subsystem provider for assistance.

Note also, that SMARTMon-UX does not launch alert emails or take any action on these events. The current release of the software only dumps them for you. If you would like to have the system generate automated alerts based on the event log, you will need to incorporate the alerts into a shell script or external program of your design.

The **-ZA** option produces the same report as the **-ZL** 199 option, only you specify the starting event number to begin reporting.

The **-ZM** option instructs the software to print a WWN-Mapping table that shows what WWNs are allocated to each logical unit.

1.52.2 LSI (Engenio) RAID Engines

LSI (previously Engenio Information Technologies, Inc.) sells RAID subsystems both under the LSI brand, as well as into the channel where other manufacturers (or VARs) re brand it as their own. As such, you might have a RAID subsystem that uses a supported LSI engine and might not know it.

The dump below is from an IBM 1742 RAID subsystem, which has a supported LSI engine. As is the case with the Infortrend RAID engine, entering the -I+ will report extended SCSI inquiry information along with vendor-unique information which describes the device in more detail. If you just send the **-I** command for basic inquiry information, the software will not attempt to discern whether or not device you selected has an LSI RAIDengine, and Infortrend RAID 206 engine, or some other RAID device.

The **-z** option sends the vendor-unique commands to query the subsystem and report information on the physical disks in the subsystem. The example below shows the data returned by the **-z** portion in RED. The **-I+** results are in blue. The data in black will be returned regardless of the engine type (assuming the device is fibre channel, SCSI, or USB host-attach interface). You can choose to enter the **-I+** without the **-z** or the -z without the **I+**.

Usage

```
smartmon-ux -I+ -z
```

Example

```
# ./smartmon-ux -z -I+ /dev/sg3
SMARTMon-ux [Release 1.27, Build 06-JUN-2004] - Copyright 2003 SANtools, Inc. http://www.SANtools.com
Discovered IBM 1742 S/N "1T99995658" on /dev/sg3 [SES] (Not Enabling SMART)(1326998 MB)
Inquiry Text Page Data - ANSI defined fields
   Device Type:                        disk
```

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```
 Peripheral Qualifier:                Connected to this LUN
 Removable Device:                    NO
 ANSI Version:                        3 (SPC ANSI X3.301:1997)
 Vendor Identification:               IBM
 Product Identification:              1742
 Firmware Revision:                   0520
 Async event reporting: (AERC)        NO
 Terminate task supported:            NO
 Response data format:                2
 Relative addressing supported:       NO
 Supports request/ACK data transfer:  NO
 Normal ACA Supported:                YES
 Enclosure services available:        YES
 Multi-ported device:                 NO
 Medium-changer attached: (removable) NO
 Linked commands supported:           NO
 Command queuing supported:           YES
 VS bit (byte #6/bit #5 set):         NO
 VS bit (byte #7/bit #0 set):         NO
 Total grown defects:                 0
 Total Primary (factory) defects:     0
 RAID Controller Information:
  Number of channels:                 4
  Processor memory:                   128 MB
  Board name:                         Series 4 Disk Array Controller
  Board part number:                  348-0046200
  Schematic number:                   348-0044310
  Schematic revision number:
  Board serial number:                1T99995658
  Date of manufacture:                09/08/02
  Board revision:
  Board identifier:                   4884
  Partition #0 type:                  Bootware
  Firmware revision:                  5.30.00
  Firmware date:                      09/05/02
  Partition #1 type:                  Application
  Firmware revision:                  5.30.12
  Firmware date:                      05/06/03
  Auto volume transfer supported:     YES
  DCE/DRM/DSS/DVE supported:          YES
  Multiple sub-enclosures supported:  YES
  Series 3 functionality supported:   YES
  Dual active controllers supported:  YES
  Maximum drives per LUN:             30
  Maximum global hot spares:          15
  Firmware download disabled:         NO
  System identifier:
  Subsystem revision level:           10.0
  Slot ID of this controller:         01
  Storage Array WWN:                  60:0a:0b:80:00:0f:0b:4f:00:00:00:00:3e:88:88:88
  Host Interface Number (*=This):     1*
  FC-0 topology:                      100-??-??-?
  FC part / chip type:                HPFC-5200
  FC part revision level:             11
  FC topology:                         Fabric
  Controller host ID switch setting:  0
  Host Interface Number (*=This):     2
  FC-0 topology:                      100-??-??-?
  FC part / chip type:                HPFC-5200
  FC part revision level:             11
  FC topology:                        Fabric
  Controller host ID switch setting:  0
Inquiry Page Hex Dump:
 0000: 00 00 03 32 1F 00 40 32 49 42 4D 20 20 20 20 20    ...2..@2IBM
 0010: 31 37 34 32 20 20 20 20 20 20 20 20 20 20 20 20    1742
 0020: 30 35 32                                           052
Inquiry EVPD Page #80h (Serial Number Page)
 0000: 00 80 00 10 31 54 32 33 33 35 35 36 35 38 20 20    ....1T99995658
 0010: 20 20 20 20
Inquiry EVPD Page #83h (Device Identification Page)
 0000: 00 83 00 14 01 03 00 10 60 0A 0B 80 00 0F 0B 4F    ........`......O
```

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```
 0010: 00 00 00 2C 3E F1 31 04                          ...,>.1.
Inquiry EVPD Page #C0h
 0000: 00 C0 00 9A 68 77 72 34 04 01 80 00 00 00 00 00  ....hwr4........
 0010: 53 65 72 69 65 73 20 34 20 44 69 73 6B 20 41 72  Series 4 Disk Ar
 0020: 72 61 79 20 43 6F 6E 74 72 6F 6C 6C 65 72 20 20  ray Controller
 0030: 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
 0040: 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
 0050: 33 34 38 2D 30 30 34 36 32 30 30 20 20 20 20 20  348-0046200
 0060: 33 34 38 2D 30 30 34 34 33 31 30 20 20 20 20 20  348-0044310
 0070: 31 54 32 33 33 35 35 36 35 38 20 20 20 20 20 20  1T99995658
 0080: 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20
 0090: 30 39 2F 30 38 2F 30 32 20 20 34 38 38 34        09/08/02  4884
Inquiry EVPD Page #C1h
 0000: 00 C1 00 2C 66 77 72 34 05 30 00 09 05 02 00 00  ...,fwr4.0......
 0010: 2E 42 57 20 05 30 00 00 09 05 02 00 00 F0 00 00  .BW .0..........
 0020: 2E 41 50 20 05 30 12 00 05 06 03 00 07 91 72 98  .AP .0........r.
Inquiry EVPD Page #C2h
 0000: 00 C2 00 2C 73 77 72 34 05 30 12 05 06 03 1F 1F  ...,swr4.0......
 0010: 2E 42 57 20 05 30 00 00 09 05 02 00 00 F0 00 00  .BW .0..........
 0020: 2E 41 50 20 05 30 12 00 05 06 03 00 07 91 72 98  .AP .0........r.
Inquiry EVPD Page #C3h
 0000: 00 C3 00 2C 70 72 6D 34 1E 0F 00 9F 00 00 00 00  ...,prm4........
 0010: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
 0020: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Inquiry EVPD Page #C4h
 0000: 00 C4 00 1C 73 75 62 73 20 20 20 20 20 20 20 20  ....subs
 0010: 20 20 20 20 20 20 20 20 31 30 2E 30 30 31 00 00          10.001..
Inquiry EVPD Page #C5h
 0000: 00 C5 00 44 68 69 6E 66 81 03 00 1C 31 30 30 2D  ...Dhinf....100-
 0010: 3F 3F 2D 3F 3F 2D 3F 20 48 50 46 43 2D 35 32 30  ??-??-? HPFC-520
 0020: 30 20 20 20 31 31 02 00 02 03 00 1C 31 30 30 2D  0   11......100-
 0030: 3F 3F 2D 3F 3F 2D 3F 20 48 50 46 43 2D 35 32 30  ??-??-? HPFC-520
 0040: 30 20 20 20 31 31 02 00                          0   11..
Inquiry EVPD Page #C6h
 0000: 00 C6 00 60 44 47 4D 50 02 00 00 00 81 10 02 00  ...`DGMP........
 0010: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
 0020: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
 0030: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
 0040: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
 0050: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
 0060: 00 00 00 00                                      ....
Inquiry EVPD Page #C7h
 0000: 00 C7 00 44 68 69 6E 32 81 03 00 1C 20 02 00 A0  ...Dhin2.... ...
 0010: B8 0F 0B 50 20 02 00 A0 B8 0F 0B 4F FF 5C 10 00  ...P ......O.\..
 0020: 00 00 00 00 00 00 00 00 02 03 00 1C 20 02 00 A0  ............ ...
 0030: B8 0F 0B 51 20 02 00 A0 B8 0F 0B 4F FF 5D 10 00  ...Q ......O.]..
 0040: 00 00 00 00 00 00 00 00                          ........
Inquiry EVPD Page #C8h
 0000: 00 C8 00 AB 65 64 69 64 01 03 00 10 60 0A 0B 80  ....edid....`...
 0010: 00 0F 0B 4F 00 00 00 2C 3E F1 31 04 3C 00 73 00  ...O...,>.1.<.s.
 0020: 69 00 63 00 61 00 30 00 30 00 32 00 5F 00 4E 00  i.c.a.0.0.2._.N.
 0030: 41 00 53 00 31 00 00 00 00 00 00 00 00 00 00 00  A.S.1...........
 0040: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
 0050: 00 00 00 00 00 00 00 00 10 60 0A 0B 80 00 0F     .........`.....
 0060: 0B 4F 00 00 00 00 3E C3 53 FE 3C 00 53 00 41 00  .O....>.S.<.S.A.
 0070: 4E 00 5F 00 41 00 53 00 44 00 00 00 00 00 00 00  N._.A.S.D.......
 0080: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
 0090: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
 00a0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00     ...............
Inquiry EVPD Page #C9h
 0000: 00 C9 00 2C 76 61 63 63 81 01 00 00 00 00 00 00  ...,vacc........
 0010: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
 0020: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Inquiry EVPD Page #CAh
 0000: 00 CA 00 16 73 6E 62 69 00 00 00 00 00 00 00 00  ....snbi........
 0010: 00 00 00 00 00 00 00 00 00 00                    ..........
Inquiry EVPD Page #D0h
 0000: 00 D0 00 14 01 03 00 10 60 0A 0B 80 00 0F 0B 4F  ........`......O
 0010: 00 00 00 00 3E 88 88 88                          ....>.S.
  Physical disk device state:
  Disk at Channel:ID 00:01 [Optimal]
```

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```
Disk at Channel:ID 00:02 [Optimal]
Disk at Channel:ID 00:03 [Optimal]
Disk at Channel:ID 00:04 [Optimal]
Disk at Channel:ID 00:05 [Optimal]
Disk at Channel:ID 00:06 [Reserved-Status]
Disk at Channel:ID 00:07 [Optimal]
Disk at Channel:ID 00:08 [Optimal]
Disk at Channel:ID 00:09 [Optimal]
Disk at Channel:ID 00:10 [Optimal]
Disk at Channel:ID 00:11 [Optimal]
Disk at Channel:ID 00:12 [Failed-WriteFailure]
Disk at Channel:ID 00:13 [Optimal]
Disk at Channel:ID 00:14 [Optimal]
Disk at Channel:ID 00:15 [Optimal]
Disk at Channel:ID 01:00 [Optimal]
Disk at Channel:ID 01:01 [Optimal]
Disk at Channel:ID 01:02 [Optimal]
Disk at Channel:ID 01:03 [Optimal]
Disk at Channel:ID 01:04 [Optimal]
Disk at Channel:ID 01:05 [Optimal]
Disk at Channel:ID 01:06 [Optimal]
Disk at Channel:ID 01:07 [Optimal]
Disk at Channel:ID 01:08 [Optimal]
Disk at Channel:ID 01:09 [Optimal]
Disk at Channel:ID 01:10 [Optimal]
Disk at Channel:ID 01:11 [Optimal]
Disk at Channel:ID 01:12 [Optimal]
Disk at Channel:ID 01:13 [Optimal]
Disk at Channel:ID 01:14 [Optimal]
Disk at Channel:ID 01:15 [Optimal]
Disk at Channel:ID 02:00 [Optimal]
Disk at Channel:ID 02:01 [Optimal]
Disk at Channel:ID 02:02 [Optimal]
Disk at Channel:ID 02:03 [Optimal]
Disk at Channel:ID 02:04 [Optimal]
Disk at Channel:ID 02:05 [Optimal]
Disk at Channel:ID 02:06 [Optimal]
Disk at Channel:ID 02:07 [Optimal]
Disk at Channel:ID 02:08 [Optimal]
Disk at Channel:ID 02:09 [Optimal]
Disk at Channel:ID 02:10 [Optimal]
```

If the selected device is a LUN that is presented by a RAID subsystem with an Infortrend controller in it, you will get the output that is highlighted in Blue. If it is not an Infortrend controller, the software will report the EVPD data described in the Inquiry Page Viewer 53 section.

Additional Information

- Unless you (or your RAID provider) has configured the engine otherwise, you can query this RAID engine by sending the **-I+** and **-z** command to any LUN.
- Significantly more information will be made available in future releases.
- RAID subsystem manufacturers and VARs/OEMs mask the make & model of RAID engine they are using by changing the make and model fields. You may have a LSI-based subsystem and not know it.
- By design, our software does NOT allow you to change any configurable parameters except for mode pages. You cannot use our software as a "configurator".
- If you send the **-z** command to a device which is not a logical disk associated with a Mylex (or Infortrend) RAID engine, the device will reject the command and our software will just reject the command.
- We support reporting all LSI defined physical device states. The values that may be returned are shown in the LSI Drive Status Definitions 204 table below. The state is shown between braces, so a drive in Optimal 204 state will be reported as **`[Optimal]`** and Out of Service 205 will be reported as **`[Out-of-Service]`**.

LSI Drive Status Definitions

Status String	Meaning
Optimal	The drive is in good condition and is currently configured as part of a LUN or global hot spare.
Unassigned	The controller has detected a drive present, but the drive

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	is not part of a configured logical unit.
Failed-CauseUnknown	Failed by alternate controller for reasons unknown. **You must replace the drive.**
Replaced	The controller has detected the replacement of a failed drive through a hot swap or an action from the host management software.
Wrong Drive Removed	The controller detected that a drive location which previously had an optimal drive now does not have a drive installed. Although there are other cases that can cause this error, the most likely is that the incorrect drive was removed or replaced by the user.
Out-of-Service	The drive was in a drive group that experienced an error during interrupted write processing that caused the LUN to transition to a DEAD state. Drives in the group that are in this state did not experience the error.
Failed-ReadFailure	Failed due to inability of drive to satisfy the read. **You must replace the drive.**
Wrong-Block-Size	The mode page for block size is improperly set. You may be able to resolve this with SANtools' mode page editor 79 function.
Reserved-Status	Reserved for future use by RAID engine.
Failed-or-Missing	The drive does not respond. **You must replace the drive.**
Capacity<Minimum	The replaced drive does not have sufficient capacity to accommodate all of the LUNs in the drive group.
Failed-FormatFailure	Write error while formatting. **You must replace the drive.**
Failed-WriteFailure	Write error. **You must replace the drive.**
Failed-ByUser	Failed due to user command.
Offline-ByUser	The drive was in a drive group that has been marked offline by the user. The LUN will transition to the DEAD state. All of the drives in the group will report this status.
Failed-ControllerStorage	Failed by controller. **You must replace the drive.**
Non-Existent	Note: Drives in this state are ignored by SANtools. Nothing will be reported for the Channel/ID combination.

1.52.3 Infortrend RAID Engines

Infortrend RAID engine support is quite robust. We report physical and logical device information and state, controller configuration, and event logs for most of the RAID products they make, and conversely, for the RAID products that other vendors make that use the Infortrend engine. The resulting output will vary slightly, depending on whether you have a SCSI-SCSI, FC-SCSI, FC-FC, or FC-SATA Infortrend engine. Below is what is reported from an off-the-shelf IFT-3102 SCSI-SCSI RAID controller attached to a Sun system. Report for other RAID engines are also shown in this section.

You may send these commands to any logical disk. Infortrend engines will process these vendor-unique commands regardless of what physical device 206 you you select for the command line.

Benefits of Directly Querying Infortrend Engines via SMARTMon-UX

- Traditionally, you manage Infortrend controllers via out-of-band software that communicates with the controller over TCP/IP. If your site has security implications, then you know in-band, direct-attach is your only option. In addition, a single machine running this software can easily manage over 100 Infortrend engines and only use a few MB of RAM, and very low CPU overhead.
- The software can tell you serial numbers of disk drives, the controller, and firmware/driver revisions. SMARTMon-UX frees you from having to take a system down to gather patch/BIOS/driver information
- If you are in a high-security area, use the -zdq command as part of a polling daemon that reports that all of the disks behind a RAID controller are online and have not been taken. We have customers who have "national

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security" implications that use the software to make sure that nobody has stolen a disk drive. Remember if you have RAID5, then somebody could take a disk drive, and the host would run normally on the degraded LUN. Our software detects disk drive removals.

- Since our software creates event log output and history files, then you can easily parse them with SNMP-based management software to integrate Infortrend controllers (or for that matter, any controller or peripheral) into your environment.

General Inquiry Usage

`smartmon-ux -I+`

Currently, the -I+ option is the only means by which our software reports vendor unique RAID information. If the selected device is a LUN that is presented by a RAID subsystem with an Infortrend controller in it, you will get the output that is highlighted in Blue. If it is not an Infortrend RAID, LSI RAID 201, or 3ware 210 controller, the software will report the EVPD data described in the Inquiry Page Viewer 53 section.

Sample Output

```
# ./smartmon-ux -I+ /dev/rdsk/c1t0d0s0
SMARTMon-ux [Release 1.27, Build  5-JUN-2004] - Copyright 2001-2004 SANtools, Inc. http://www.SANtools.com
Discovered IFT 3102 S/N "3072051" on /dev/rdsk/c1t0d0s0 (SMART unsupported)(17501 MB)
 Inquiry Text Page Data - ANSI defined fields
   Device Type:                          disk
   Peripheral Qualifier:                 Connected to this LUN
   Removable Device:                     NO
   ANSI Version:                         2 (SCSI-2 ANSI X3.131:1994)
   ISO/IEC Version:                      0
   ECMA Version:                         0
   Vendor Identification:                IFT
   Product Identification:               3102
   Firmware Revision:                    0223
   Async event reporting: (AERC)         NO
   Supports 16-bit wide addresses:       NO
   Supports 32-bit wide addresses:       NO
   Supports ACKQ/REQQ handshaking:       NO
   Terminate task supported:             NO
   Response data format:                 2
   Relative addressing supported:        NO
   Supports request/ACK data transfer:   NO
   Normal ACA Supported:                 NO
   32-bit parallel supported:            NO
   16-bit parallel supported:            YES
   Synchronous commands supported:       YES
   Linked commands supported:            NO
   Command queuing supported:            YES
   SAF-TE Enclosure services available:  NO
   VS bit (byte #6/bit #5 set):          NO
   VS bit (byte #7/bit #0 set):          NO
   RAID Controller Information:
    Controller firmware revision:        2.23K
    Controller boot firmware:            1.12H
    Number of host channels:             2
    Number of drive channels:            1
    Processor memory:                    2048 MB
    Processor type:                      5X86-133(WB)
    Board serial number:                 870329856
    Mode flags bit map:                  07030400
    Write back:                          Disabled
    Motor spin up:                       Disabled
    Power up SCSI reset:                 Disabled
    Battery backup support:              No
    Battery backup present:              No
    Error correction enabled:            No
    LUN assignment by SCSI ID support:   Yes
    SCSI LUNs > 0 supported:             Yes
    Spanning logical drives supported:   No
    Controller user-defined name:        SFILE01
    Controller make:                     IFT
```

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```
   Controller model:                  IFT-3102
   Cache mode flags bit map:          01000000
   Write back status:                 Disabled
   Cache optimization:                Large/SeqIO
   Disk Interface Type:               SCSI
   Number of cache blocks:            939786240
   Number of dirty cache blocks:      0
  Inquiry Page Hex Dump:
   0000: 00 00 02 02 FA 00 00 32 49 46 54 20 20 20 20 20    ....ú..2IFT
   0010: 33 31 30 32 20 20 20 20 20 20 20 20 20 20 20 20    3102
   0020: 30 32 32 33 20 33 30 37 32 30 35 31 00 00 00 00    0223 3072051....
   0030: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
   0040: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
   0050: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
   0060: 00 00 43 6F 70 79 72 69 67 68 74 28 43 29 31 39    ..Copyright(C)19
   0070: 39 35 20 49 6E 66 6F 72 74 72 65 6E 64 20 41 6C    95 Infortrend Al
   0080: 6C 20 72 69 67 68 74 73 20 72 65 73 65 72 76 65    l rights reserve
   0090: 64 30 30 30 30 00 00 00 00 00 00 00 00 00 00 00    d0000...........
   00a0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
   00b0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
   00c0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
   00d0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
   00e0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
   00f0: 6A 1E A0 18 01 00 00 00 00 00 00 00 00 00          j. ..........
```

Below is the same command issued to an Infortrend fibre host attach controller with fibre channel disk drives for comparison.

```
# ./smartmon-ux -I+ /dev/sg
SMARTMon-ux [Release 1.27, Build  5-JUN-2004] - Copyright 2001-2004 SANtools, Inc. http://www.SANtools.com
Discovered IFT ER2000R1 S/N "3221234" on /dev/sde (SMART unsupported)(492 MB)
 Inquiry Text Page Data - ANSI defined fields
   Device Type:                       disk
   Peripheral Qualifier:              Connected to this LUN
   Removable Device:                  NO
   ANSI Version:                      3 (SPC ANSI X3.301:1997)
   Vendor Identification:             IFT
   Product Identification:            ER2000R1
   Firmware Revision:                 0323
   Async event reporting: (AERC)      NO
   Terminate task supported:          NO
   Response data format:              2
   Relative addressing supported:     NO
   Supports request/ACK data transfer: NO
   Normal ACA Supported:              NO
   Enclosure services available:      NO
   Multi-ported device:               NO
   Medium-changer attached: (removable) NO
   Linked commands supported:         NO
   Command queuing supported:         YES
   VS bit (byte #6/bit #5 set):       NO
   VS bit (byte #7/bit #0 set):       NO
   RAID Controller Information:
    Controller firmware revision:     3.23W
    Controller boot firmware:         1.21F
    Number of host channels:          1
    Number of drive channels:         3
    Processor memory:                 128 MB
    Processor type:                   PPC750
    Board serial number:              3221234
    Mode flags bit map:               00040107
    Write back:                       Enabled
    Motor spin up:                    Enabled
    Power up SCSI reset:              Enabled
    Battery backup support:           Yes
    Battery backup present:           No
    Error correction enabled:         No
    LUN assignment by SCSI ID support: No
    SCSI LUNs > 0 supported:          No
    Spanning logical drives supported: Yes
    Controller user-defined name:     David
    Controller make:                  IFT
```

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```
   Controller model:                  ER2000R1
   Cache mode flags bit map:          00000101
   Write back status:                 Enabled
   Cache optimization:                Large/SeqIO
   Number of cache blocks:            32652
   Number of dirty cache blocks:      0
   Motor spin-up:                     Enabled
   Power-up reset:                    Enabled
   Predictive failure:                Disabled
   Host Interface Type:               Fibre Channel
   Disk Interface Type:               Fibre Channel
   :                        10.0.0.1
   Subnet Mask:                       255.0.0.0
   Gateway:                           0.0.0.0
 Inquiry Page Hex Dump:
  0000: 00 00 03 02 FA 00 00 02 49 46 54 20 20 20 20 20    ........IFT
  0010: 45 52 32 30 30 30 52 31 20 20 20 20 20 20 20 20    ER2000R1
  0020: 30 33 32 33 20 33 32 32 31 32 33 34 00 00 00 00    0323 3221234....
  0030: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  0040: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  0050: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  0060: 43 6F 70 79 72 69 67 68 74 20 28 43 29 20 31 39    Copyright (C) 19
  0070: 39 39 20 49 6E 66 6F 72 74 72 65 6E 64 2E 20 41    99 Infortrend. A
  0080: 6C 6C 20 72 69 67 68 74 73 20 72 65 73 65 72 76    ll rights reserv
  0090: 65 64 2E 00 00 00 00 00 00 00 00 00 00 00 00 00    ed..............
  00a0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  00b0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  00c0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  00d0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  00e0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00    ................
  00f0: 6A 1E A0 18 53 0B 00 00 00 00 00 00 00 00          j...S.........
 Inquiry EVPD Page #80h (Serial Number Page)
  0000: 00 80 00 10 20 33 32 32 31 32 33 34 20 20 20 20    .... 3221234
  0010: 20 20 20 20
 Inquiry EVPD Page #83h (Device Identification Page)
  0000: 00 83 00 20 01 03 00 08 20 00 00 D0 23 00 0B 54    ... .... ...#..T
  0010: 01 03 00 10 60 0D 02 30 00 31 24 92 00 0B 54 09    ....`..0.1$...T.
  0020: 6E 82 25 00                                        n.%.
 Inquiry EVPD Page #D0h
  0000: 00 D0 00 30 20 00 00 00 C9 23 04 FE 10 00 00 00    ...0 ....#......
  0010: C9 23 04 FE 65 00 00 01 00 00 00 00 20 00 00 D0    .#..e....... ...
  0020: 23 00 0B 53 21 00 00 D0 23 00 0B 53 25 00 00 01    #..S!...#..S%...
  0030: 04 00 00 00                                        ....
```

Infortrend Event Log Reporting:

If you wish to view the state of all physical and logical devices in your RAID engine, use the **-zi** command as shown below. The syntax and results will be the same regardless of what type of host or drive interface the particular RAID engine uses.

```
[root@BOSS smartmon]# ./smartmon-ux -zi /dev/sde
SMARTMon-ux [Release 1.28, Build 01-APR-2005] - Copyright 2001-2005 SANtools, Inc. http://www.SANtools.com
Discovered IFT ER2000R1 S/N "3221234" on /dev/sde (SMART unsupported)(492 MB)

 Physical Device Dump: (DeviceMake-Model [Firmware] S/N=SerialNumber Blocks Channel.ID:LUN)
   IBM     DNEF-309170 [FYG2] S/N=AJ1P3500 4294443136 Blocks at 2.52:00h [FAILED]
   SEAGATE ST336704FC [0002] S/N=3CD0W3BW 71163200 Blocks at 2.53:00h [ONLINE]
   IBM     DNEF-309170 [F90F] S/N=AJ1P8126 17392064 Blocks at 2.54:00h [ONLINE]
   IBM     DNEF-318350 [F90F] S/N=AK0LS733 35319488 Blocks at 2.55:00h [HOTSPARE-GLOBAL]
   IBM     DNEF-309170 [F90F] S/N=AJ1Q3584 4294443136 Blocks at 2.56:00h [FAILED]
   IBM     DNEF-318350 [F90F] S/N=AK0LS056 35319488 Blocks at 2.57:00h [UNCONFIGURED]
   IBM     DNEF-309170 [F90C] S/N=AJ18V426 17392064 Blocks at 2.58:00h [ONLINE]
   IBM     DNEF-309170 [FYG3] S/N=AJ1P3267 17392064 Blocks at 2.59:00h [ONLINE]
   IBM     DNEF-309170 [F90F] S/N=AJ197182 4294443136 Blocks at 2.5a:00h [FAILED]
   SEAGATE ST1181677FC [0001] S/N=3EM044M0 354075840 Blocks at 2.5b:00h [UNCONFIGURED]
   IBM     DNEF-309170 [F90C] S/N=AJ18Q223 17392064 Blocks at 2.5c:00h [ONLINE]
   HITACHI DK31CJ-72FC [JJAJ] S/N=1D233942 143886720 Blocks at 2.5d:00h [UNCONFIGURED]
 RAID Controller Logical Device Dump:
   LD[0] State=[INCOMPLETE] NONRAID DeviceSize=17392064 Blocks
```

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```
LD[1] State=[INCOMPLETE] RAID-0 DeviceSize=34783232 Blocks
LD[2] State=[OPTIMAL] RAID-1 DeviceSize=17391616 Blocks
LD[3] State=[OPTIMAL] RAID-1 DeviceSize=17391616 Blocks
```

General Enclosure and State Reporting:

This function decodes and reports the internal event log along with some environmental state information. The state information will appear first, followed by the event log. The number of environmental lines will vary depending on whether or not the RAID engine is in a SAF-TE or SES enclosure and/or if those features are enabled. The dump below was taken from the same engine that we used to report the -zi information above, so you can see the effects of the failed disks on channel 52h 208 and 5Ah 208.

All further dumps in this section were run on the same controller.

```
[root@BOSS smartmon]# ./smartmon-ux  -zie /dev/sde
SMARTMon-ux [Release 1.28, Build 01-APR-2005] - Copyright 2001-2005 SANtools, Inc. http://www.SANtools.com
Discovered IFT ER2000R1 S/N "3221234" on /dev/sde (SMART unsupported)(492 MB)

    Redundant controller configuration: Primary
    Redundant controller status:        Scanning
    Original controller role:           Secondary
    Current  controller role:           Secondary
    UPS status:                         OK
Information [#1 Type 0181h at 18:28:13 03/29/2005] Controller initialization complete on Primary controller.
Alert [#2 Type 0124h at 18:31:18 03/29/2005] UPC AC power loss detected on Primary controller.
Warning [#3 Type 113Fh at 18:38:58 03/29/2005] Channel 0 reported that a redundant loop failure has been
detected. Now using the surviving logical channel 2.
Warning [#4 Type 113Fh at 18:52:58 03/29/2005] Channel 0 reported that a redundant loop failure has been
detected. Now using the surviving logical channel 2.
Warning [#5 Type 113Fh at 18:54:57 03/29/2005] Channel 1 (ID 82/52h) reported that a redundant path failure
was detected.  Now using redundant logical channel 1.
Warning [#6 Type 1101h at 18:55:01 03/29/2005] Channel 1 (ID 82/52h) reported a select timeout, sector=0h.
Alert [#7 Type 2101h at 18:55:02 03/29/2005] SCSI drive failed on logical drive 0(channel=1, id=82/52h,
lun=0).
Warning [#8 Type 113Fh at 19:01:45 03/29/2005] Channel 1 (ID 89/59h) reported that a redundant path failure
was detected.  Now using redundant logical channel 1.
Warning [#9 Type 1101h at 19:01:45 03/29/2005] Channel 1 (ID 89/59h) reported a select timeout, sector=0h.
Warning [#10 Type 113Fh at 19:12:49 03/29/2005] Channel 1 (ID 86/56h) reported that a redundant path failure
was detected.  Now using redundant logical channel 1.
Warning [#11 Type 1101h at 19:12:49 03/29/2005] Channel 1 (ID 86/56h) reported a select timeout, sector=0h.
Alert [#12 Type 2101h at 19:12:50 03/29/2005] SCSI drive failed on logical drive 0(channel=1, id=86/56h,
lun=0).
Warning [#13 Type 113Fh at 19:13:26 03/29/2005] Channel 1 (ID 90/5ah) reported that a redundant path failure
was detected.  Now using redundant logical channel 1.
Warning [#14 Type 1101h at 19:13:26 03/29/2005] Channel 1 (ID 90/5ah) reported a select timeout, sector=0h.
Alert [#15 Type 2101h at 19:13:27 03/29/2005] SCSI drive failed on logical drive 0(channel=1, id=90/5ah,
lun=0).
Information [#16 Type 2183h at 19:13:42 03/29/2005] Rebuild continued on logical drive 0.
Information [#17 Type 2184h at 19:23:58 03/29/2005] Rebuild paused due to state change on logical drive 0.
Information [#18 Type 113Fh at 21:08:50 03/29/2005] Channel 0 reported that the fibre loop connection has
been restored.
```

Full RAID Controller Event Log:

The **-ziL** option returns basically the same results as the -zie option, but it does not report any enclosure information. This option only reports the event log.

```
[root@BOSS smartmon]# ./smartmon-ux -ziL /dev/sde
SMARTMon-ux [Release 1.28, Build 01-APR-2005] - Copyright 2001-2005 SANtools, Inc. http://www.SANtools.com
Discovered IFT ER2000R1 S/N "3221234" on /dev/sde (SMART unsupported)(492 MB)

Information [#1 Type 0181h at 18:28:13 03/29/2005] Controller initialization complete on Primary controller.
Alert [#2 Type 0124h at 18:31:18 03/29/2005] UPC AC power loss detected on Primary controller.
Warning [#3 Type 113Fh at 18:38:58 03/29/2005] Channel 0 reported that a redundant loop failure has been
detected. Now using the surviving logical channel 2.
Warning [#4 Type 113Fh at 18:52:58 03/29/2005] Channel 0 reported that a redundant loop failure has been
detected. Now using the surviving logical channel 2.
Warning [#5 Type 113Fh at 18:54:57 03/29/2005] Channel 1 (ID 82/52h) reported that a redundant path failure
was detected.  Now using redundant logical channel 1.
Warning [#6 Type 1101h at 18:55:01 03/29/2005] Channel 1 (ID 82/52h) reported a select timeout, sector=0h.
```

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```
Alert [#7 Type 2101h at 18:55:02 03/29/2005] SCSI drive failed on logical drive 0(channel=1, id=82/52h,
lun=0).
Warning [#8 Type 113Fh at 19:01:45 03/29/2005] Channel 1 (ID 89/59h) reported that a redundant path failure
was detected.  Now using redundant logical channel 1.
Warning [#9 Type 1101h at 19:01:45 03/29/2005] Channel 1 (ID 89/59h) reported a select timeout, sector=0h.
Warning [#10 Type 113Fh at 19:12:49 03/29/2005] Channel 1 (ID 86/56h) reported that a redundant path failure
was detected.  Now using redundant logical channel 1.
Warning [#11 Type 1101h at 19:12:49 03/29/2005] Channel 1 (ID 86/56h) reported a select timeout, sector=0h.
Alert [#12 Type 2101h at 19:12:50 03/29/2005] SCSI drive failed on logical drive 0(channel=1, id=86/56h,
lun=0).
Warning [#13 Type 113Fh at 19:13:26 03/29/2005] Channel 1 (ID 90/5ah) reported that a redundant path failure
was detected.  Now using redundant logical channel 1.
Warning [#14 Type 1101h at 19:13:26 03/29/2005] Channel 1 (ID 90/5ah) reported a select timeout, sector=0h.
Alert [#15 Type 2101h at 19:13:27 03/29/2005] SCSI drive failed on logical drive 0(channel=1, id=90/5ah,
lun=0).
Information [#16 Type 2183h at 19:13:42 03/29/2005] Rebuild continued on logical drive 0.
Information [#17 Type 2184h at 19:23:58 03/29/2005] Rebuild paused due to state change on logical drive 0.
```

Detailed RAID Controller and Peripheral Report:

The **-zix** command is designed for storage diagnostic engineers, and should not be used unless the LUNs on the RAID engine are offline and no longer satisfying I/O requests from application software.
The information that is returned is controller and device-specific configuration hex dumps.

Partial RAID Controller Event Log:

The **-ziA** flag is like the -ziL 209 flag, but it lets you control the starting number and total count of event log entries. You would ordinarily use this command as part of a script.

```
[root@BOSS smartmon]# ./smartmon-ux -ziA 4 2  /dev/sde
SMARTMon-ux [Release 1.28, Build 01-APR-2005] - Copyright 2001-2005 SANtools, Inc. http://www.SANtools.com
Discovered IFT ER2000R1 S/N "3221234" on /dev/sde (SMART unsupported)(492 MB)

Warning [#4 Type 113Fh at 18:52:58 03/29/2005] Channel 0 reported that a redundant loop failure has been
detected. Now using the surviving logical channel 2.
Warning [#5 Type 113Fh at 18:54:57 03/29/2005] Channel 1 (ID 82/52h) reported that a redundant path failure
was detected.  Now using redundant logical channel 1.
```

Additional Information

- Unless you (or your RAID provider) has configured the engine otherwise, you can query this RAID engine by sending the **-I+** command to any LUN.
- RAID subsystem manufacturers and VARs/OEMs mask the make & model of RAID engine they are using by changing the make and model fields. You may have an Infortrend-based subsystem and not know it.
- By design, our software does NOT allow you to change any configurable parameters except for mode pages. You cannot use our software as a "configurator".

Continuous Infortrend Polling

The **-zm** command can be used to continuously poll an Infortrend RAID engine. You would generally combine this flag with the **-F** flag which allows you to specify a polling interval. Otherwise, it will use the default polling interval of 10 minutes.

1.52.4 3WARE AMCC RAID Engines

Support for the 3-WARE / AMCC family RAID engines is limited to the 7xxxx, 8xxx, and 9xxx family. This includes the controllers that work with both SATA and ATA (PATA) disk drives.

The full inquiry command -I+ 54 reports controller-specific information such as firmware revisions and make/model information. The text highlighted in blue is specific o 3-WARE controllers. There is a chance that you have a 3ware-based controller, but the identification strings have been changed because the controller is relabeled by an OEM. If our software does not properly report that you have a 3-WARE engine because of this, please let us know, and we will make the necessary modifications and supply you with an update. The 3ware API does not provide an elegant way to determine if the controller is a 3-WARE controller, so we rely on interpreting SCSI strings rather than sending what may be invalid commands which might confuse a non-3ware device.

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Benefits of Directly Querying 3WARE / AMCC Controllers

- Use the software to assess RAID health remotely, and not be dependent on a BIOS-based program, or a utility that only runs on the host console. Since the output can easily be parsed and scripted, the administrator can implement a phone-home system based on specific parameters. Obviously this can't be done from a BIOS because the host isn't even running an O/S. Limitations in vendor supplied tools prevent you from creating customized actions based on health.
- The software can tell you serial numbers of disk drives, the controller, and firmware/driver revisions. SMARTMon-UX frees you from having to take a system down to gather patch/BIOS/driver information
- If you are in a high-security area, use the **-z3d** command as part of a polling daemon that reports that all of the disks behind a RAID controller are online and have not been taken. We have customers who have "national security" implications that use the software to make sure that nobody has stolen a disk drive. Remember if you have RAID5, then somebody could take a disk drive, and the host would run normally on the degraded LUN. Our software detects disk drive removals behind RAID controllers as not only does it report differences in devices, but it gives you the unique serial numbers 212.

```
[root@frank smartmon]# ./smartmon-ux -I+ /dev/sg9

SMARTMon-ux [Release 1.30, Build 03-DEC-2005] - Copyright 2001-2005 SANtools, Inc. http://www.SANtools.com
Discovered 3ware Logical Disk 00 S/N " " on /dev/sg9 (SMART unsupported)(76283 MB)
 Inquiry Text Page Data - ANSI defined fields
   Device Type:                        disk
   Peripheral Qualifier:               Connected to this LUN
   Removable Device:                   NO
   ANSI Version:                       0 (Not ANSI compliant)
   ISO/IEC Version:                    0
   ECMA Version:                       0
   Vendor Identification:              3ware
   Product Identification:             Logical Disk 00
   Firmware Revision:                  1.00
   Async event reporting: (AERC)       NO
   Supports 16-bit wide addresses:     NO
   Supports 32-bit wide addresses:     NO
   Supports ACKQ/REQQ handshaking:     NO
   Terminate task supported:           NO
   Response data format:               2
   Relative addressing supported:      NO
   Supports request/ACK data transfer: NO
   Normal ACA Supported:               NO
   32-bit parallel supported:          NO
   16-bit parallel supported:          NO
   Synchronous commands supported:     NO
   Linked commands supported:          NO
   Command queuing supported:          YES
   SAF-TE Enclosure services available: NO
   VS bit (byte #6/bit #5 set):        NO
   VS bit (byte #7/bit #0 set):        NO
   Total Capacity (In Bytes):          199988609024        <- Added in 1.30
   RAID Controller Information:
    Manufacturer:                      3ware (AMCC)
    Serial Number:                     F19002A4430575
    Model:                             9500S-4LP
    PCB Revision:                      Rev 019
    P-chip Version:                    1.50
    A-chip Version:                    3.20                <- Added in 1.30
    Firmware Version:                  FE9X 2.04.00.003
    BIOS Version:                      BE9X 2.03.01.047
    Monitor Version:                   BL9X 2.02.00.001
    JBOD Policy:                       Enabled
    Cache Policy when Degraded:        Enabled             <- Added in 1.30
    AV Mode:                           Disabled            <- Added in 1.30
    Battery Backup Unit:               Not Present
    Battery Backup Unit Status:        N/A
    JBOD Policy:                       N/A
    Number of physical disks:          2
    Number of logical disks:           1
```

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```
    Number of disk ports:              4                  <- Added in 1.30
  Inquiry Page Hex Dump:
   0000: 00 00 00 02 1F 00 00 02 33 77 61 72 65 20 20 20    ........3ware
   0010: 4C 6F 67 69 63 61 6C 20 44 69 73 6B 20 30 30 20    Logical Disk 00
   0020: 31 2E 30                                           1.0
```

You may use the -z3 option to display physical and logical device information ...

```
[root@frank smartmon]# ./smartmon-ux -z3 /dev/sg9
SMARTMon-ux [Release 1.28, Build 01-APR-2005] - Copyright 2001-2005 SANtools, Inc. http://www.SANtools.com
Discovered 3ware Logical Disk 00 S/N " " on /dev/sg9 (SMART unsupported)(76283 MB)

 Physical Device Dump: (DeviceMake-Model [Firmware] S/N=SerialNumber Blocks DiskNumber.ControllerPort
[DeviceState]
   WDC WD2000JD-00FYB0  [02.05D02] S/N=WD-WMAEH2469728        190782 MB at ID.Port 0.1 [OK]
   Maxtor 6Y080M0       [YAR51BW0] S/N=Y3JRAGXE               78167 MB at ID.Port 1.3 [OK]
 Logical Device Dump:
   RAID-1    76283 MB at SCSIID 0 [DEGRADED]

Program Ended.
```

Reporting AMCC Internal Diagnostic Log (-zd3)

This function should be used in the event the controller or drives report some problem, and can be used by the manufacturer to further diagnose the problem. The format is controlled by the controller manufacturer, and it is subject to change. We suggest you do not attempt to write any scripts to parse it.

Here is a subset of a dump. Note the "** End of Diagnostic dump **" string. If you are trying to parse the dump programmatically, then you may look for this string to indicate the end of the dump.

```
[root@frank smartmon]# ./smartmon-ux -z3d /dev/sg2
SMARTMonUX [Release 1.30, Build  5-DEC-2005] - Copyright 2001-2005 SANtools, Inc. http://www.SANtools.com
Discovered 3ware Logical Disk 00 S/N " " on /dev/sg2 (SMART unsupported)(190724 MB)

 Physical Device Dump: (DeviceMake-Model [Firmware] S/N=SerialNumber Blocks DiskNumber.ControllerPort [DeviceState]
   WDC WD2000JD-00FYB0  [02.05D02] S/N=WD-WMAEH2469728        190782 MB at ID.Port 0.0 [OK]
   Maxtor 6Y080M0       [YAR51BW0] S/N=Y3JRAGXE               78167 MB at ID.Port 1.3 [OK]
 Logical Device Dump:
   SINGLEDISK   190724 MB at SCSIID 0 [OK]
   SINGLEDISK    76283 MB at SCSIID 1 [OK]

 Controller Diagnostic Dump
0 A0 C2 4F 01 01 00

E=0208 I=008E89EC T=00:29:44     : Drive not ready
E=0208 I=008E89EC T=00:29:44 U=0 : Return error status to host
Error, Unit 0: Drive not ready
(EC:0x208, SK=0x04, ASC=0x08, ASCQ=0x00, SEV=01, Type=0x70)
opcode=0xB1
E=0208 I=FFFFD7C4 T=00:29:44 P=0 : Drive not ready, no retries
       ata task file written out : cd dh ch cl sn sc ft
                                : B0 A0 C2 4F 01 01 D1
         ata task file read back : st dh ch cl sn sc er
                                : D0 A0 C2 4F 01 01 00

E=0208 I=008E8A3C T=00:29:44     : Drive not ready
E=0208 I=008E8A3C T=00:29:44 U=0 : Return error status to host
Error, Unit 0: Drive not ready
(EC:0x208, SK=0x04, ASC=0x08, ASCQ=0x00, SEV=01, Type=0x70)
opcode=0xB1
E=0208 I=FFFFD7C4 T=00:29:44 P=0 : Drive not ready, no retries
       ata task file written out : cd dh ch cl sn sc ft
                                : B0 A0 C2 4F 01 01 D1
         ata task file read back : st dh ch cl sn sc er
                                : D0 A0 C2 4F 01 01 00

E=0208 I=008E8A8C T=00:29:44     : Drive not ready
E=0208 I=008E8A8C T=00:29:44 U=0 : Return error status to host
Error, Unit 0: Drive not ready
(EC:0x208, SK=0x04, ASC=0x08, ASCQ=0x00, SEV=01, Type=0x70)
```

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```
opcode=0xB1
E=0208 I=FFFFD7C4 T=00:29:44 P=0 : Drive not ready, no retries
       ata task file written out : cd dh ch cl sn sc ft
                                : B0 A0 C2 4F 01 01 D1
         ata task file read back : st dh ch cl sn sc er
                                : D0 A0 C2 4F 01 01 00


E=0208 I=008E8E9C T=00:29:44     : Drive not ready
E=0208 I=008E8E9C T=00:29:44 U=0 : Return error status to host
Error, Unit 0: Drive not ready
(EC:0x208, SK=0x04, ASC=0x08, ASCQ=0x00, SEV=01, Type=0x70)
opcode=0xB1
Saving PRINTLOG, time=2300170 ...
  ** End of Diagnostic Dump **

Program Ended.
```

Reporting AMCC Internal Event Log (-z3L)

This reports the contents of the controller's internal event log. The format is fixed and it is suitable for parsing. Here is an example of what you would expect to see on a power up. Event log entries are numbered sequentially from zero, and a power cycle clears the log.

```
[root@frank smartmon]# ./smartmon-ux -z3L /dev/sg2
SMARTMonUX [Release 1.30, Build  5-DEC-2005] - Copyright 2001-2005 SANtools, Inc. http://www.SANtools.com
Discovered 3ware Logical Disk 00 S/N " " on /dev/sg2 (SMART unsupported)(190724 MB)

 Physical Device Dump: (DeviceMake-Model [Firmware] S/N=SerialNumber Blocks DiskNumber.ControllerPort [DeviceState]
   WDC WD2000JD-00FYB0  [02.05D02] S/N=WD-WMAEH2469728        190782 MB at ID.Port 0.0 [OK]
   Maxtor 6Y080M0       [YAR51BW0] S/N=Y3JRAGXE                78167 MB at ID.Port 1.3 [OK]
 Logical Device Dump:
   SINGLEDISK   190724 MB at SCSIID 0 [OK]
   SINGLEDISK    76283 MB at SCSIID 1 [OK]

 Controller Event Log Dump
  Event#  0: Code=0000h @ Wed Dec 31 18:00:00 1969 (0x04:0x0000): AEN queue empty
```

Reporting AMCC Internal Event Log (-z3m)

This reports the health of the subsystem as part of a background monitoring daemon. You would add it as a runtime parameter when you run the program as either a windows service or UNIX/LINUX daemon. You should combine it with the -F flag to set a polling interval. (If you do not set the polling flag, then the health will be queried every 10 minutes).

1.52.5 LSI (MPT Internal) RAID Engines

Benefits of Directly Querying LSI RAID Controllers

- Use the software to assess RAID health remotely, and not be dependent on a BIOS-based program, or a utility that only runs on the host console. Since the output can easily be parsed and scripted, the administrator can implement a phone-home system based on specific parameters. Obviously this can't be done from a BIOS because the host isn't even running an O/S. Limitations in LSI-supplied windows-based tools prevent you from creating customized actions based on health.
- The software can tell you serial numbers of disk drives, the controller, and firmware/driver revisions. SMARTMon-UX frees you from having to take a system down to gather patch/BIOS/driver information
- If you are in a high-security area, use the -zdq command as part of a polling daemon that reports that all of the disks behind a RAID controller are online and have not been taken. We have customers who have "national security" implications that use the software to make sure that nobody has stolen a disk drive. Remember if you have RAID5, then somebody could take a disk drive, and the host would run normally on the degraded LUN. Our software detects disk drive removals behind LSI-based RAID controllers.
- Do you have newer 6Gbit SAS disks, and/or SATA drives? Is everything synced up to highest supported speed? Look at the Link Max/min 214 rates to find out.

The results below show **`/etc/smartmon-ux -zd /dev/es/ses0`**
(You must give it the device name for something that is attached to a LSI internal RAID controller. In this case, the

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controller is the LSISAS3800X card, which is a JBOD controller.)

```
SMARTMon-UX [Release 1.38, Build  30-OCT-2008] - Copyright 2001-2008 SANtools(R), Inc. http://www.SANtools.
com
Discovered LSILOGIC SYM3600-SAS S/N "0617053320" on /dev/es/ses0 [SES] (Enclosure Services)
Discovered (1) Controllers:


Port #0. /proc/mpt/ioc0    RAID SAS1068 A0     MPT 105   Firmware (1.16.00.01)   IOC 0
 x86 BIOS image's version: MPTBIOS-6.12.00.00 (2006.10.31)
Bus/Dev/Fun    Board Name       Board Assembly   Board Tracer
130   3   0     SAS1068
SAS1068's phylinks are (Port 0,1,...,8): 3.0 G, 3.0 G, 3.0 G, 3.0 G, down, down, down, down

Firmware Settings
-----------------
SAS WWID:                       500605b0000488c0
Multi-pathing:                  Disabled
SATA Native Command Queuing:    Enabled
SATA Write Caching:             Enabled
SATA Maximum Queue Depth:       32
Device Missing Report Delay:    0 seconds
Device Missing I/O Delay:       0 seconds
Phy Parameters for Phynum:      0    1    2    3    4    5    6    7
  Link Enabled:                 Yes  Yes  Yes  Yes  Yes  Yes  Yes  Yes
  Link Min Rate:                1.5  1.5  1.5  1.5  1.5  1.5  1.5  1.5
  Link Max Rate:                3.0  3.0  3.0  3.0  3.0  3.0  3.0  3.0
  SSP Initiator Enabled:        Yes  Yes  Yes  Yes  Yes  Yes  Yes  Yes
  SSP Target Enabled:           No   No   No   No   No   No   No   No
  Port Configuration:           Auto Auto Auto Auto Auto Auto Auto Auto
Target IDs per enclosure:       1
Persistent mapping:             Enabled
Physical mapping type:          None
Target ID 0 reserved for boot:  No
Starting slot (direct attach):  0
Target IDs (physical mapping):  0
Interrupt Coalescing:           Enabled, timeout is 16 us, depth is 16

Persistent Mappings
-------------------
Persistent entry 0 is valid, Bus 0 Target 0 is PhysId 5000c5000040f53d
Persistent entry 1 is valid, Bus 0 Target 1 is PhysId 0523270354666c41
Persistent entry 2 is valid, Bus 0 Target 2 is PhysId 0523270354666f3e
Persistent entry 3 is valid, Bus 0 Target 3 is PhysId 0523270354666d4b
Persistent entry 4 is valid, Bus 0 Target 4 is PhysId 0523270354666c4a
Persistent entry 5 is valid, Bus 0 Target 5 is PhysId 5000c5000694c6ea
Persistent entry 6 is valid, Bus 0 Target 6 is PhysId 5000c5000694be86
Persistent entry 7 is valid, Bus 0 Target 7 is PhysId 5000c5000694bb7a
Persistent entry 8 is valid, Bus 0 Target 8 is PhysId 5000c5000694beae
Persistent entry 9 is valid, Bus 0 Target 9 is PhysId 5000c5000694c0de
Persistent entry 10 is valid, Bus 0 Target 10 is PhysId 5000c5000694bffe
Persistent entry 11 is valid, Bus 0 Target 11 is PhysId 500a0b82e0850019
Persistent entry 12 is valid, Bus 0 Target 12 is PhysId 5000c5000694c6e9
Persistent entry 13 is valid, Bus 0 Target 13 is PhysId 5000c5000694be85
Persistent entry 14 is valid, Bus 0 Target 14 is PhysId 5000c5000694bb79
Persistent entry 15 is valid, Bus 0 Target 15 is PhysId 5000c5000694bead
Persistent entry 16 is valid, Bus 0 Target 16 is PhysId 5000c5000694c0dd
Persistent entry 17 is valid, Bus 0 Target 17 is PhysId 5000c5000694bffd
Persistent entry 18 is valid, Bus 0 Target 18 is PhysId 500a0b82e0894019
SAS1068's links are 3.0 G, 3.0 G, 3.0 G, 3.0 G, down, down, down, down

 B___T___L  Vendor   Product          Rev      SASAddress     PhyNum
 0  12   0  SEAGATE  ST3146855SS      MS01  5000c5000694c6e9     0
 0  13   0  SEAGATE  ST3146855SS      MS01  5000c5000694be85     1
 0  14   0  SEAGATE  ST3146855SS      MS01  5000c5000694bb79     2
 0  15   0  SEAGATE  ST3146855SS      MS01  5000c5000694bead     3
 0  16   0  SEAGATE  ST3146855SS      MS01  5000c5000694c0dd     5
 0  17   0  SEAGATE  ST3146855SS      MS01  5000c5000694bffd    11
 0  18   0  LSILOGIC SYM3600-SAS      0166  500a0b82e0894019    24
RAID is not supported on this port
RAID is not supported on this port
```

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```
RAID is not supported on this port


Program Ended.
```

The results below show **/etc/smartmon-ux -zdL /dev/es/ses0**
This particular controller doesn't support an event log, but the dump will still provide information about the firmware and chipset.

```
SMARTMon-UX [Release 1.36, Build  8-JUN-2008] - Copyright 2001-2008 SANtools(R), Inc. http://www.SANtools.
com
Discovered LSILOGIC SYM3600-SAS S/N "0617053320" on /dev/es/ses0 [SES] (Enclosure Services)
Discovered (1) Controllers:

mpt0             RAID SAS1068 A0     MPT 105   Firmware 01100001   IOC 0
This controller does not support event logging
The event log is empty for the above controller, or the feature is not supported by the firmware


Program Ended.
```

Reporting disk drives only (the -zdq command)

The results below do an efficient scan to just report physical disks seen by the operating system, as well as disk drives that are hidden behind logical disks created by RAID firmware, using the command **smartmon-ux -zdq** This dump was run on a LINUX host that uses a LSI controller configured in RAID-1 mode. Note that some of the disks report a physical device (/dev/hdb, /dev/sda, /dev/sdb, /dev/sdc). Those disks are directly seen by the operating system. The HP disk at "Bus 0 Target 5" is only seen by the RAID controller and invisible to the operating system. (Note for security reasons, the serial numbers were manually changed in this document).

```
[root@w13 /scratch/common]# ./smartmon-ux -zdq
SMARTMon-UX [Release 1.38, Build 30-OCT-2008] - Copyright 2001-2008 SANtools(R), Inc. http://www.SANtools.
com
Discovered TSSTcorpCDW/DVD TS-L462D S/N "" on /dev/hdb (SMART unsupported)
Discovered ATA ST3500630NS S/N "9QG43RVS" on /dev/sda (Not Enabling SMART)(476940 MB)
Discovered HP DF072BAFDT S/N "BJL4P86004TB0862" at Bus 0 Target 5 (Not Enabling SMART) (70007 MB)
Discovered ATA WDC WD2500AAJS-2 S/N "WD-WMART1663509" on /dev/sdb (Not Enabling SMART)(238475 MB
Discovered LSILOGIC Logical Volume S/N "" on /dev/sdc (SMART unsupported)(69618 MB)
```

Here is the **-zd** dump from the same system, that reveals more about the configuration and how the disks are used.

```
[root@w13 /scratch/common]# ./smartmon-ux -zd
SMARTMon-UX [Release 1.38, Build 30-OCT-2008] - Copyright 2001-2008 SANtools(R), Inc. http://www.SANtools.
com
Discovered TSSTcorpCDW/DVD TS-L462D S/N "" on /dev/hdb (SMART unsupported)
Discovered ATA ST3500630NS S/N "9QG43RVS" on /dev/sda (Not Enabling SMART)(476940 MB)

Discovered (1) Controllers:

Port #0. /proc/mpt/ioc0    RAID SAS1068 B1     MPT 105   Firmware (1.18.00)   IOC 0
 x86 BIOS image's version: MPTBIOS-6.12.00.00 (2006.10.31)
Bus/Dev/Fun    Board Name       Board Assembly   Board Tracer
130   3   0     SAS1068
SAS1068's phylinks are (Port 0,1,...,8): 1.5 G, down, 3.0 G, down, down, 3.0 G, down, down

Firmware Settings
-----------------
SAS WWID:                     500d068000003505
Multi-pathing:                Disabled
SATA Native Command Queuing:  Enabled
SATA Write Caching:           Enabled
SATA Maximum Queue Depth:     32
Device Missing Report Delay:  0 seconds
Device Missing I/O Delay:     0 seconds
Phy Parameters for Phynum:    0    1    2    3    4    5    6    7
  Link Enabled:               Yes  Yes  Yes  Yes  Yes  Yes  Yes  Yes
  Link Min Rate:              1.5  1.5  1.5  1.5  1.5  1.5  1.5  1.5
  Link Max Rate:              3.0  3.0  3.0  3.0  3.0  3.0  3.0  3.0
  SSP Initiator Enabled:      Yes  Yes  Yes  Yes  Yes  Yes  Yes  Yes
```

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```
  SSP Target Enabled:           No   No   No   No   No   No   No   No
  Port Configuration:           Auto Auto Auto Auto Auto Auto Auto Auto
Target IDs per enclosure:       1
Persistent mapping:             Disabled
Physical mapping type:          Direct Attach
Target ID 0 reserved for boot:  No
Starting slot (direct attach):  0
Target IDs (physical mapping):  0
Interrupt Coalescing:           Enabled, timeout is 16 us, depth is 4

Persistent Mappings
-------------------
No persistent entries found
SAS1068's phylinks are (Port 0,1,...,8): 1.5 G, down, 3.0 G, down, down, 3.0 G, down, down

Discovered ST3500630NS S/N "9QG43RVS" on RAID (Not Enabling SMART) (476940 MB)
Discovered WDC WD2500AAJS-22VTA0 S/N "WD-WMART1663590" on RAID (Not Enabling SMART) (238475 MB)
Discovered LSILOGIC Logical Volume S/N "" on RAID (Not Enabling SMART) (69618 MB)
1 volume is active, 2 physical disks are

Volume 0 is Bus 0 Target 4, Type IM (Integrated Mirroring)
  Volume Name:
  Volume WWID:  0a0cade5ed79d4ab
  Volume State:  degraded, enabled
  Volume Settings:  write caching disabled, auto configure
  Volume draws from Hot Spare Pools:  0
  Volume Size 69618 MB, Stripe Size 0 KB, 2 Members
  Volume Device:
   Member 1 is PhysDisk 0 at (Bus 0 Target 5)

Discovered HP DF072BAFDT S/N "BJL4P86004TB0862" at Bus 0 Target 5 (70007 MB)  state=online PhysDisk=0
Discovered HP DF072BABUD S/N "J2YD2PCA" at Bus 0 Target 8 (70007 MB)  state=missing, out of sync PhysDisk=1
Volume 0 State:  degraded, enabled
Volume 1 State:  optimal, disabled
```

(Additional output follows, but was truncated as it isn't relevant to the **-zd** command)

There are several points of interest in this dump.

- Note that the HP Disk S/N J2YD2PCA shows state=missing. That is because this disk is no longer plugged into the system,
- Some ports 215 are running at 1.5 Gbit/sec, others are running at 3 Gbit/sec
- The logical device is degraded 216 (one disk is missing from the RAID-1 mirror)

1.53 Background Media Scan Functions

Reasonably current SCSI, FC and SAS disk drives (such as the Seagate 10K.5 family and above) have a programmable feature that lets the disk be configured so it scans the disk for correctable errors during idle time. If your disk has this firmware and capability, you can us the software to configure, disable, and report test results.

What is Background Scanning

The best way to describe background media scanning and explain the benefits comes from Seagate's patent #7490261 - Background media scan for recovery of data errors. The following abridged text comes from the published patent itself:

> ***"Media defects can arise at any sector on your disk drive during the lifetime of the storage system (grown defects). These grown defects include, for example, invading foreign particles which become embedded onto the surface of the disc, or external shocks to the storage system which can cause the transducer to nick or crash onto the surface of the disc. Defective sectors pose either temporary or permanent data retrieval problems.***
>
> ***Read errors are typically determined when the host computer attempts to retrieve user data from a sector and one or more uncorrected errors exist. Typically, the data storage system includes internally programmed error recovery routines such that upon determination of a read error, the data storage system applies a variety of corrective operations to recover user data. Occasionally, the data storage system exhausts all available corrective operations for recovery of data without success. The data***

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storage system will declare a hard error and reallocate the sector by mapping out the bad sector and substituting an unused, reserved sector. The use of these corrective operations and reallocation functions can require a significant amount of time during retrieval of user data and thus, limit the maximum data transfer rate of the data storage system."

It does not matter whether you are using JBOD, hardware RAID or software-based RAID, BGMS will provide profound improvement in reliability and data integrity with near-zero overhead.

Benefits of BGMS

First, BGMS will fix bad blocks on-the-fly as they are discovered by the firmware. The disk drive will use idle time to perform multiple re-reads to correct the data. As the bad blocks are discovered BEFORE the O/S actually needs the data on those blocks, then no programs have to suspend processing while bad blocks are repaired. If your host is streaming movies into hotel rooms, then user's won't suffer through the experience of a movie stopping for 5-30 seconds while the host and/or RAID subsystem go through the data recovery/remapping process.

If you are using software RAID, then BGMS can somewhat replace data consistency checks, and provide somewhat self-healing storage farms. In the event the BGMS-enabled disk can not repair a bad block, then you can use the report SMARTMonUX generates to provide you a list of physical disk drives and offsets where you know you have unrecoverable data. You can then use a shell script to find bad blocks 220, then either run a parity rebuild, or issue a single command to repair the bad stripe by reading the part of the RAID volume that incorporates the bad block(s). By issuing a read, the RAID software will discover for itself that there is unreadable data and it will fix it for you.

By exploiting the power of BGMS, you could effectively scan and repair any size storage farm 24x7 without the inherent overhead when the host tries to scan & repair bad blocks via brute-force techniques.

Disable Background Media Scanning

The **-bmsd** command disables background media scanning.

Usage

```
smartmon-ux -bmsd DeviceList
```

Enable Background Media Scanning

The **-bmse** command disables background media scanning.

Usage

```
smartmon-ux -bmse n DeviceList
```

Where: n represents the hourly scanning interval. Once the disk is programmed to enable scanning, the disk will automatically begin a new scan after the supplied interval. If disk power is lost, the timer will automatically reset to zero, and scanning will automatically continue. Send the -bmsd 217 command to stop and disable scanning.

Report Background Media Scan Results

The **-bmsr** command disables background media scanning.

Usage

```
smartmon-ux -bmsr DeviceList
```

The command below was run on a SPARC Solaris 10 system that has 6 SAS disks. We added the time command to the prompt so that you can see how quickly the command runs. This was also run with wild-cards to select all disks attached to controller #4.

```
# time ./smartmon-ux -bmsr /dev/rdsk/c4*s0
SMARTMon-UX [Release 1.36, Build  8-JUN-2008] - Copyright 2001-2008 SANtools(R), Inc. http://www.SANtools.
com
Discovered SEAGATE ST3146855SS S/N "3LN23ER0" on /dev/rdsk/c4t12d0s0 (Not Enabling SMART)(140014 MB)


Background Media Scan Report @ Sun Jun  8 16:33:03 2008
Accumulated power-on minutes:            135086 [94 days]
```

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```
Number of background scans performed:     34
Background scanning status:               medium scan halted, waiting for interval timer expiration
Background scan percentage completed:     0.00
Defect#   PowerOnMins   HexBlockNumber   State   Reassignment Status            AdditionalInfo
      0             8           577a4b   OK      recovered via in-place rewrite  Recovered error Recovered
data with retries
      1         46392            381f8   OK      recovered via in-place rewrite  Recovered error Recovered
data with retries
      2         46402          7598a8e   OK      recovered via in-place rewrite  Recovered error Recovered
data with retries
      3        117139          2cfae2a   OK      recovered via in-place rewrite  Recovered error Recovered
data with retries
      4        117149          9c9036c   OK      recovered via in-place rewrite  Recovered error Recovered
data with retries
      5        131136          77b3f4d   OK      recovered via in-place rewrite  Recovered error Recovered
data with retries
      6        135041          77339d3   OK      recovered via in-place rewrite  Recovered error Recovered
data with retries

Discovered SEAGATE ST3146855SS S/N "3LN2A027" on /dev/rdsk/c4t13d0s0 (Not Enabling SMART)(140014 MB)


Background Media Scan Report @ Sun Jun  8 16:33:03 2008
Accumulated power-on minutes:             134976 [94 days]
Number of background scans performed:     34
Background scanning status:               medium scan halted, waiting for interval timer expiration
Background scan percentage completed:     0.00
Number of defects reported:               0

Discovered SEAGATE ST3146855SS S/N "3LN29PAS" on /dev/rdsk/c4t14d0s0 (Not Enabling SMART)(140014 MB)


Background Media Scan Report @ Sun Jun  8 16:33:03 2008
Accumulated power-on minutes:             134904 [94 days]
Number of background scans performed:     35
Background scanning status:               medium scan halted, waiting for interval timer expiration
Background scan percentage completed:     0.00
Defect#   PowerOnMins   HexBlockNumber   State   Reassignment Status            AdditionalInfo
      0           148          d99d9f7   OK      recovered via in-place rewrite  Recovered error Recovered
data with retries
      1          8855          761f75d   OK      recovered via in-place rewrite  Recovered error Recovered
data with retries

Discovered SEAGATE ST3146855SS S/N "3LN29ZZ5" on /dev/rdsk/c4t15d0s0 (Not Enabling SMART)(140014 MB)


Background Media Scan Report @ Sun Jun  8 16:33:04 2008
Accumulated power-on minutes:             134325 [93 days]
Number of background scans performed:     35
Background scanning status:               medium scan halted, waiting for interval timer expiration
Background scan percentage completed:     0.00
Defect#   PowerOnMins   HexBlockNumber   State   Reassignment Status            AdditionalInfo
      0           133            37fc7   OK      recovered via in-place rewrite  Recovered error Recovered
data with retries
      1        117114          2bf620f   OK      recovered via in-place rewrite  Recovered error Recovered
data with retries
      2        130954               7b   ERR     waiting for WRITE              Controller/drive hardware
failed Track following error
      3        130954              1c8   ERR     waiting for WRITE              Controller/drive hardware
failed Track following error
      4        130954            37fc7   OK      recovered via in-place rewrite  Recovered error Recovered
data with retries
      5        131392            37fc8   OK      recovered via in-place rewrite  Recovered error Recovered
data with retries
      6        133380            38039   OK      recovered via in-place rewrite  Recovered error Recovered
data with retries
      7        133792          d699104   OK      recovered via in-place rewrite  Recovered error Recovered
data with retries

Discovered SEAGATE ST3146855SS S/N "3LN27XJ9" on /dev/rdsk/c4t16d0s0 (Not Enabling SMART)(140014 MB)
```

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```
Background Media Scan Report @ Sun Jun  8 16:33:04 2008
Accumulated power-on minutes:             134950 [94 days]
Number of background scans performed:     38
Background scanning status:               medium scan halted, waiting for interval timer expiration
Background scan percentage completed:     0.00
Defect#   PowerOnMins   HexBlockNumber   State   Reassignment Status            AdditionalInfo
      0         46356          3b46c18   OK      recovered via in-place rewrite  Recovered error Recovered
data with retries
      1        133307            80a34   ERR     recovered via in-place rewrite  Controller/drive hardware
failed Track following error

Discovered SEAGATE ST3146855SS S/N "3LN29QG4" on /dev/rdsk/c4t17d0s0 (SMART enabled)(140014 MB)


Background Media Scan Report @ Sun Jun  8 16:33:04 2008
Accumulated power-on minutes:             134993 [94 days]
Number of background scans performed:     35
Background scanning status:               medium scan halted, waiting for interval timer expiration
Background scan percentage completed:     0.00
Defect#   PowerOnMins   HexBlockNumber   State   Reassignment Status            AdditionalInfo
      0           127            381a8   OK      recovered via in-place rewrite  Recovered error Recovered
data with retries
      1         46378          de80f44   OK      recovered via in-place rewrite  Recovered error Recovered
data with retries
      2         56468          3a44867   OK      recovered via in-place rewrite  Recovered error Recovered
data with retries
      3         86795          a817a7f   OK      recovered via in-place rewrite  Recovered error Recovered
data with retries
      4        130059          de863e6   OK      recovered via in-place rewrite  Recovered error Recovered
data with retries
      5        131031            1e240   ERR     waiting for WRITE               Controller/drive hardware
failed Track following error
      6        132850          e01e8c4   OK      recovered via in-place rewrite  Recovered error Recovered
data with retries
      7        133350             1f62   ERR     waiting for WRITE               Controller/drive hardware
failed Track following error
      8        133350            8034a   ERR     waiting for WRITE               Controller/drive hardware
failed Track following error
      9        133350            805b4   ERR     waiting for WRITE               Controller/drive hardware
failed Track following error
     10        134778          e01e8fa   OK      recovered via in-place rewrite  Recovered error Recovered
data with retries

Program Ended.


real    0m1.15s
user    0m0.01s
sys     0m0.02s
#
```

The PowerOnMins field represents the total minutes that the disk has been powered on. The value is non-volatile, so the minutes increase only while the disk is powered on. The fields marked with ERR correspond to defects that are in need of repair. These are bad blocks that can not be read. If the disks are part of a software RAID set, then you should launch a data consistency repair using whatever utility is appropriate for your operating system.

Note that it took a little over one second to report all unrecoverable blocks for nearly one terabyte worth of storage. The blocks that it reports were discovered during prior automated background media scans (see the -bmse 217 function in this section).

Using Media Scan Results with Software RAID

BGMS not only improves data integrity by automatically repairing failing blocks by rewriting them, but can also provide enough information to construct a script to rebuild software RAID volumes when the need arises. For example, if you have two disks that mirror each other (RAID-1),and smartmon-ux tells you that block #1234 is bad and unreadable, then you can instruct the operating system to run a consistency repair on the volume to recover. If the media scan results **`-bmsr`** reports that there are no bad blocks, then there is no need to run a manual check for bad blocks that could take hours or even days if you have a large storage pool.

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The script, FindBadBlocks.sh 220 utilizes the **-bmsr** function to enumerate all bad blocks and report them by slice (the equivalent of a partition). This, in turn, can be used by the system administrator to determine whether or not a repair is warranted for any particular volume. This script was run against the same Solaris 10 system that supplied the scan results shown above 217.

```
./FindBadBlocks.sh
PhysicalDevPath    Days:Hrs:Min  Offset State
/dev/rdsk/c1t2d0s0             -       - OK
/dev/rdsk/c4t12d0s0     0:00:08  577a4b Recovered via in-place rewrite
/dev/rdsk/c4t12d0s0    32:05:12   381f8 Recovered via in-place rewrite
/dev/rdsk/c4t12d0s0    32:05:22 7598a8e Recovered via in-place rewrite
/dev/rdsk/c4t12d0s0    81:08:19 2cfae2a Recovered via in-place rewrite
/dev/rdsk/c4t12d0s0    81:08:29 9c9036c Recovered via in-place rewrite
/dev/rdsk/c4t12d0s0    91:01:36 77b3f4d Recovered via in-place rewrite
/dev/rdsk/c4t12d0s0    93:18:41 77339d3 Recovered via in-place rewrite
/dev/rdsk/c4t14d0s0     0:02:28 d99d9f7 Recovered via in-place rewrite
/dev/rdsk/c4t14d0s0     6:03:35 761f75d Recovered via in-place rewrite
/dev/rdsk/c4t15d0s0     0:02:13   37fc7 Recovered via in-place rewrite
/dev/rdsk/c4t15d0s0    81:07:54 2bf620f Recovered via in-place rewrite
/dev/rdsk/c4t15d0s0    90:22:34      7b ERR waiting for WRITE Controller/drive hardware failed Track following error
/dev/rdsk/c4t15d0s0    90:22:34     1c8 ERR waiting for WRITE Controller/drive hardware failed Track following error
/dev/rdsk/c4t15d0s0    90:22:34   37fc7 Recovered via in-place rewrite
/dev/rdsk/c4t15d0s0    91:05:52   37fc8 Recovered via in-place rewrite
/dev/rdsk/c4t15d0s0    92:15:00   38039 Recovered via in-place rewrite
/dev/rdsk/c4t15d0s0    92:21:52 d699104 Recovered via in-place rewrite
/dev/rdsk/c4t16d0s0    32:04:36 3b46c18 Recovered via in-place rewrite
/dev/rdsk/c4t16d0s0    92:13:47   80a34 Recovered via in-place rewrite
/dev/rdsk/c4t17d0s0     0:02:07   381a8 Recovered via in-place rewrite
/dev/rdsk/c4t17d0s0    32:04:58 de80f44 Recovered via in-place rewrite
/dev/rdsk/c4t17d0s0    39:05:08 3a44867 Recovered via in-place rewrite
/dev/rdsk/c4t17d0s0    60:06:35 a817a7f Recovered via in-place rewrite
/dev/rdsk/c4t17d0s0    90:07:39 de863e6 Recovered via in-place rewrite
/dev/rdsk/c4t17d0s0    90:23:51   1e240 ERR waiting for WRITE Controller/drive hardware failed Track following error
/dev/rdsk/c4t17d0s0    92:06:10 e01e8c4 Recovered via in-place rewrite
/dev/rdsk/c4t17d0s0    92:14:30    1f62 ERR waiting for WRITE Controller/drive hardware failed Track following error
/dev/rdsk/c4t17d0s0    92:14:30   8034a ERR waiting for WRITE Controller/drive hardware failed Track following error
/dev/rdsk/c4t17d0s0    92:14:30   805b4 ERR waiting for WRITE Controller/drive hardware failed Track following error
/dev/rdsk/c4t17d0s0    93:14:18 e01e8fa Recovered via in-place rewrite
```

1.53.1 Finding Bad Blocks Script

This is the source code for the **FindBadBlocks.sh** script shown in previous section. It has only been tested under Solaris 10, but serves as an example of what can be done to extend the functionality of the **-bmsr** 217 command.

```
#!/bin/ksh
#
# Script Copyright 2008 SANtools (R) Inc.
# By David A. Lethe  david@santools.com
#
# This script parses bmsr output and provides list of devices and known bad blocks
# It is not in public domain
#
Headed=0
function Header {
        if [ $Headed -eq 0 ] ; then
                printf "PhysicalDevPath    Days:Hrs:Min  Offset State\n"
                Headed=1
        fi
}

function OK {
        printf "%-20s          -       - OK\n" $LASTDEV
}

TFILE=/tmp/smartscan.$$
/etc/smartmon-ux -bmsr > $TFILE
LASTGOOD=""
cat $TFILE | while read a b c d e f LASTDEV h
do
```

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```
   if [ "$a" = "Discovered" ] ; then
           if [ "$b" == "SEAGATE" ] ; then
                   read a b ; read a b
                   if [ "$a" != "-Background" ] ; then
                          read x; read x; read x; read x; read x; read a b
                          if [ "$a" == "Defect#" ] ; then
                                 DONE=0 ; COUNT=0 ; BAD=0
                                 while read n pow blk REASON
                                 do
                                        if [ "$n" == $COUNT ] ; then
                                               BAD=`expr $BAD + 1`
                                               Header
                                               DAYS=`expr $pow / 1440`
                                               MIN=`expr $pow - $DAYS '*' 1440`
                                               HRS=`expr $MIN / 60`
                                               MIN=`expr $MIN - $HRS '*' 60`
                                               printf "%-20s%5d:%02d:%02d%8s " $LASTDEV $DAYS $HRS $MIN $blk
                                               CANDIDATE=`echo $REASON|grep WRITE`
                                               if [ "$CANDIDATE" != "" ] ; then
                                                      echo $REASON
                                               else
                                                      CANDIDATE=`echo $REASON|grep 'recovered via in`
                                                      if [ "$CANDIDATE" != "" ] ; then
                                                             REASON="Recovered via in-place rewrite"
                                                      fi
                                                      echo $REASON
                                               fi
                                               COUNT=`expr $COUNT + 1`
                                        else
                                               if [ "$BAD" -eq 0 ] ; then
                                                      Header
                                                      OK
                                               fi
                                               break
                                        fi
                                 done
                          fi
                   else
                          Header
                          OK
                   fi
           fi
   fi
done
rm -f $TFILE
```

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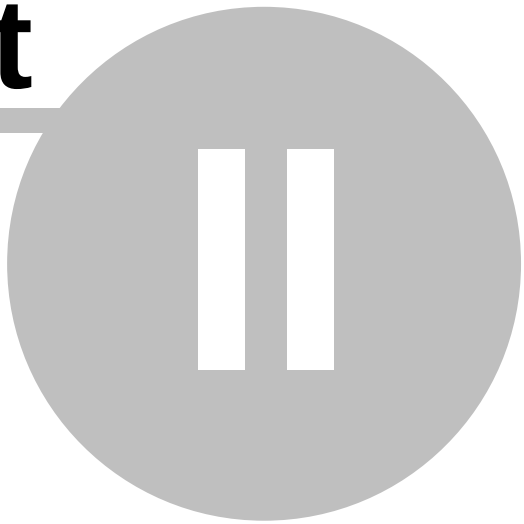
Part



2 What Do I Do If I Get an Alert

2.1 What Does an Alert Look Like?

Disk-Related Messages

In the event a S.M.A.R.T. alert is generated by your disk drive, it will be detected by SMARTMon-UX the next time the program polls the disk. If you have the email option (**-M**) invoked, your system will send out an email similar to: "**Device on /dev/hd1 SMART Status:FAILED - Failure imminent".**

The message header will be "**SMARTMon Alert from computer.domain.**" (i.e., **SMARTMon Alert from system.mydomain.com**).

You should take some immediate actions to minimize possibility of data loss.

In addition, this information will be recorded in the Windows Event log or smartmon-ux.log if running Windows family operating systems or the standard UNIX/LINUX syslog file. See use of the **-L** 19 and **-LRemote** 248 command to control the names of the log files for your particular operating system. The example below shows what the software reports on a failing SAS disk

```
# tail /var/log/smartmon-ux
Tue Jun 10 11:11:24 2008: /dev/rdsk/c4t16d0s0 polled at Tue Jun 10 11:20:24 2008 Status:Passed
Tue Jun 10 11:11:24 2008: /dev/rdsk/c4t17d0s0 polled at Tue Jun 10 11:20:24 2008 Status:Passed
Tue Jun 10 11:21:24 2008: /dev/rdsk/c1t1d0s0 polled at Tue Jun 10 11:21:24 2008 Status:Passed
Tue Jun 10 11:21:24 2008: /dev/rdsk/c1t2d0s0 polled at Tue Jun 10 11:21:24 2008 Status:Passed
Tue Jun 10 11:21:24 2008: /dev/rdsk/c4t12d0s0 polled at Tue Jun 10 11:21:24 2008 Status:Passed
Tue Jun 10 11:21:25 2008: /dev/rdsk/c4t13d0s0 polled at Tue Jun 10 11:21:24 2008 Status:Passed
Tue Jun 10 11:21:25 2008: /dev/rdsk/c4t14d0s0 polled at Tue Jun 10 11:21:25 2008 Status:Passed
Tue Jun 10 11:21:25 2008: /dev/rdsk/c4t15d0s0 polled at Tue Jun 10 11:21:25 2008 Status:FAILED - Failure
imminent (Predictive Failure Analysis (S.M.A.R.T.) threshold reached)
Tue Jun 10 11:21:25 2008: /dev/rdsk/c4t16d0s0 polled at Tue Jun 10 11:21:25 2008 Status:Passed
Tue Jun 10 11:21:25 2008: /dev/rdsk/c4t17d0s0 polled at Tue Jun 10 11:21:25 2008 Status:Passed
```

Enclosure-Related Messages (SES)

If you have a component fail in your SES enclosure, the message text might contain something like:
PSU #0 Critical DC failure [LED ON] XYRATEX SS-1202-FCAL 50-05-0C-C0-00-00-3D-DD

The SES code within SMARTMon-UX returns status text messages for all SES pages defined within the specification. Note that not all SES enclosures monitor all components defined in the spec. You should contact your storage vendor to learn which SES Components 229 monitor their hardware. Below is a list of components that SMARTMon-UX monitors and reports

- **SES Device Status Element (i.e.,** disk drive status)
- **SES Array Element (i.e.**, is the device a hot spare, part of a critical array, rebuilding, etc...)
- **SES Cooling Element** (fans, and fan speed)
- **SES Temperature Element** (returns temperature and thermal overtemp/undertemp warnings)
- **SES Power Element** (includes over/under voltage and AC/DC power loss)
- **SES Door Lock Element** (for each device bay)
- **SES Audible Alarm Status Element** (muted, enabled, sounding, etc...)
- **SES Electronics Status Element**
- **SCC Electronics Status Element**
- **SES Volatile Cache Status Element**
- **SES UPS Status Element** (includes battery status, and AC/DC power status)
- **SES SCSI Port Status Element**
- **SES Language Element Status Element**
- **SES Communication Port Status Element**
- **SES Voltage Sensor Status Element (displays input voltage)**
- **SES Current Sensor Status Element (displays current drawn)**
- **SES SCSI Initiator Port Status Element**

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In addition, if there is an alert, the software will report the make and model of enclosure along with the world-wide name.

Regardless of the message type. SMARTMon-UX will make an entry in either the default system log or a log file specific to smartmon-ux, if the program was invoked with the **-L** option.

Enclosure-Related Messages (SAF-TE)
If you have a component fail in your SAF-TE enclosure, the message text might contain something like:
Critical - Power Supply #1 Malfunctioning (Commanded on) CNSi JSS122

The SAF-TE code within SMARTMon-UX returns status text messages for all SAF-TE devices defined within the specification. Note that not all SES enclosures monitor all components defined in the spec. You should contact your storage vendor to learn which SAF-TE components their hardware monitors. Below is a list of components that SMARTMon-UX monitors **and reports**

- **Fan Status** (Operational; malfunctioning; not installed; unknown)
- **Power Supply Status** (Operational and on; Operational and off; Malfunctioning and commanded on; Malfunctioning and commanded off; Not present; Present; Unknown)
- **Door Lock Status** (Locked; Unlocked; Unknown)
- **Speaker Status** (Off/No Speaker Installed; On)
- **Temperature** (Reports value in degrees Celsius and Fahrenheit)
- **Device Slot status** (for each device bay) Reports No device inserted in slot, Device inserted in slot, Device power on, Device power off; SCSI ID of device in slot

In addition, if there is an alert, the software will report the make and model of enclosure along with the world-wide name.

Regardless of the message type. SMARTMon-UX will make an entry in either the default system log or a log file specific to smartmon-ux, if the program was invoked with the **-L** option.

2.2 What Immediate Actions Should I Take

If the alert is related to the enclosure, such as a redundant power supply failure, contact your storage vendor for further instructions.

If, however, the alert is disk-related, do NOT recycle power on your system (if you can help it). This is because recycling power puts the greatest amount of stress on disk drives, and it is possible your drive will not spin up again after spinning down.

You should then immediately back-up your data and replace your hard disk drive, because a failure may be imminent. Sometimes you have a few hours. Other times the drive will work properly for days or even months. The important thing to remember is that your very sophisticated drive's internal diagnostics have detected a condition where the drive is in a degrading mode. One or more components are now out of specification.

You should contact Technical Support and give them the reported message. They will take necessary measures and will inform you accordingly.

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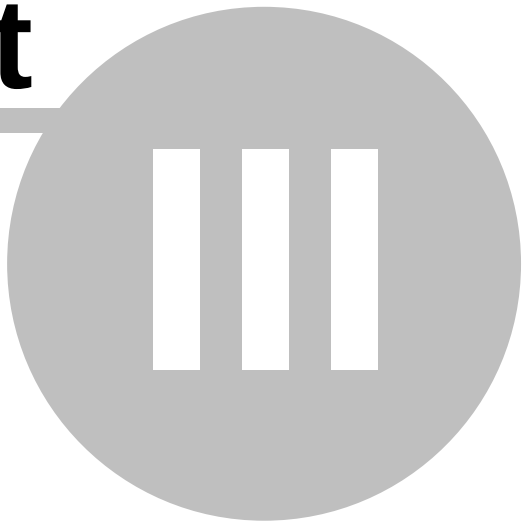
Part



3 Getting Help

3.1 About SMARTMon-UX

If this software was bundled on your computer or storage subsystem by your hardware vendor, you must contact them for technical support. If however, you purchased the software directly from us, you may contact us by sending E-MAIL to support@santools.com

Our URLs:

Main:	http://www.SANtools.com
S.M.A.R.T. Disk Monitor	http://www.SANtools.com/smartmon
This online manual	http://www.SANtools.com/smart/unix/manual

Please remember that we are not experts on what each error message or warning on a device means. We also cannot tell you how much life is left in a drive once it records a critical error.

We do report all significant information which will allow you to have a meaningful conversation with your computer vendor who will assess if the condition warrants a replacement. Sometimes the problem is in your controller, cabling, or device configuration.

3.2 Contacting Your Supplier

S.M.A.R.T. Disk Monitor provides critical information such as serial and model numbers, as well as diagnostic and historical data. You can use this information to answer any questions your technical support contact should have regarding the problem you are seeing. With this information you should have no problems expressing the problems you are having.

You might also want to consider sending them a copy of the system log file that reports all events, SCSI Sense codes, and time stamps. In addition, running the program as **`/etc/smartmon-ux -I -A`** will provide invaluable mode page and inquiry page data that an engineer may wish to know about. Sometimes making a change to a mode page will fix a problem.

For intermittent problems, you might also wish to define a shorter polling period.

Here are some other things to consider when contacting your disk supplier:

- Warranty periods vary depending on the disk's make and model. Your supplier might only offer 90 days, where the manufacturer offers 5 years.
- If you have an OEM drive, the original manufacturer typically will not repair or replace the drive. You will have to go to your supplier. For example, HP brands Seagate and IBM disk drives. Seagate and IBM will not necessarily be able to support you because your disk is a model made for HP only. You will have to contact HP for support.
- A vast majority of the time, the problem with a disk comes down to operator error. They are improperly cabled, configured, or terminated. Sometimes the device drivers are improperly installed. Sometimes your tech support person may be skeptical because the last 100 drives they took back on a RMA turned out to be just fine. Just relax. We have never had a problem returning a drive if they were under warranty.

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Part

4 Frequenty Asked Questions

4.1 What are Sense Codes?

Sense data contains detailed information about error conditions. It is organized into major categories called *sense keys* and sub categories called *additional sense codes* (ASC) and *additional sense code qualifiers* (ASCQ). The combination of these data fields can finely convey detailed information about the error condition.

Whenever a command is sent to a SCSI device, the sense data is made available to the device driver.

The sense keys are generic and have the same meaning regardless of the type of device. For example, sense key #1 means to "Check Condition", but the command completed. Combined with the ASC and ASCQ bytes, the condition check might actually translate into something like, "**`Fly Height Change Problem, Recommend Device Replacement`**". Which would be the case if you had an IBM DGHS Ultrastar and received sense Code of 5d, qualifier 00, additional codes 02 25.

Your syslog file may have these types of messages in them, so in the event of a problem, you should inspect this file.

4.2 What is S.M.A.R.T. and How Does it Work?

S.M.A.R.T. is an acronym for ***S**elf-**M**onitoring, **A**nalysis and **R**eporting **T**echnology*, an open standard for developing disk drives and software systems that automatically monitor a disk drive's health and report potential problems. Ideally, if a problem is reported, you have enough time to take proactive actions to prevent impending disk crashes.

A S.M.A.R.T. drive monitors the internal performance of the motors, media, heads, and electronics of the drive, while our software monitors the overall reliability status of the drive. The reliability status is determined through the analysis of the drive's internal performance level and the comparison of internal performance levels to predetermined threshold limits.

How does S.M.A.R.T. Work?

Part of what makes the S.M.A.R.T. system possible is that disk drive reliability has been intensely studied for many years. Manufacturers spend billions of dollars researching how vital areas of disk drives change over time and operating environments. By analyzing this data, they can define performance thresholds, which correlate to imminent failures.

SMART Disk Monitor turns on this capability, interacts with it, and reports these conditions to the system administrator.

Mode Page 1C Settings

All SCSI, Fibre Channel, SSA, and SAS disks allow an application to configure the S.M.A.R.T. behavior by making changes in mode page 1C. As these changes affect how the disk responds to I/Os when the disk triggers a SMART condition, it is important that we share this with you along with our rationality for having things the way they are.

ANSI-Defined Field Name	Description	SMARTMon-UX Setting	Notes
PERF	**Perf**ormance bit	0. This is configurable with **-P** 19 option	Enable this for high-throughput i.e., video streaming systems. The disk drive will prioritize application I/O over SMART diagnostics.
EWASC	**E**nable **W**arning bit	1	If disk supports this bit, it will be set to 1, otherwise 0.
DEXCPT	**D**isable **E**xception bit	0	0 means to turn ON SMART, 1 means turn off SMART. Use the **-p** 78 flag to turn SMART off
MRIE	**M**ethod of **R**eporting	6	Setting **MRIE** to 6 is preferred, as a SMART alert will only be

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	Interval **E**xceptions	(But if 6 not supported, it tries 4, then 3)	sent in response to a request for it. **MRIE** of 4 means that the disk will unconditionally generate a CHECK CONDITION (recovered error) sense error on I/Os when/if disk becomes degraded and SMART kicks in. Setting bit to 3 conditionally generates the same errors, depending on a mode page setting. **MRIE** values of 3 & 4 have higher overhead due to requirement that log pages are updated once SMART alert kicks in, but 6 is not supported on all disk drives.
Interval Timer	Period between subsequent SMART error messages	Defaults to 10 minutes unless -F command used to poll more frequently	The original ANSI spec draft that describes SMART suggested a 10 minute polling interval. The delay with **PERF** off is typically under 400 ms and under 150 ms with **PERF** on. You will have to consult your disk drive vendor's documentation for specific timing values.
Report Count	# of times to report SMART status per interval	0	This means there will be no limit to number of times SMART is reported in response to a query.

4.3 What are Mode Pages, and How are they Used?

Mode page commands are used to read or set a wide range of device parameters. They are applicable to all devices that use the SCSI command set. This includes SCSI tapes, fibre channel disk drives, and SCSI CDROMs and disk drives. IDE disk drives do not use mode pages, nor do CDROMs that use the IDE interface.

Mode pages should never be changed unless you completely understands its function. As they make fundamental changes to the way a device operates, improper settings can destroy data or render a device invisible to the operating system. Conversely, proper settings of mode pages can have significant performance benefits. For example, generally IBM disables write cache on your disk drives. If you are in a write-intensive environment, you might almost double performance by enabling it. (At the risk of data loss if you do not have a UPS connected to your computer and you have a power failure).

Your computer and disk drive vendors are the best source for determining how to best modify mode pages for your operating system and what types of programs you run. They may also tell you if certain mode pages are not supported by them, as they might sacrifice data integrity for performance.

This document does not provide a tutorial on what each mode page does, and how it is used. We just supply you software which allows you to view and manipulate mode pages.

The ANSI specification defines a set of mode pages which are typically found in many devices. As most people are concerned with mode pages specific to disk drives, some of them are shown below to give you an idea of what they are good for. Manufacturers are also free to define vendor-specific pages. Some may be documented online in their disk drive programming specification manuals. Other pages may only be available under a non-disclosure agreement.

4.4 SES Specific Definitions

For SES, the following definitions, abbreviations, acronyms, symbols, keywords, and editorial conventions apply.

application client: An object that is the source of SCSI commands and destination for responses to commands. SMARTMon is the application client.
array device: A device in the enclosure, typically a disk drive.
command descriptor block: The structure up to 16 bytes in length used to communicate commands from

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application client to a device server.
critical condition: An enclosure condition established when one or more elements inside the enclosure have failed or are operating outside of their specifications. The failure of the element makes continued normal operation of at least some elements in the enclosure impossible. Some elements within the enclosure may be able to continue normal operation.
device: A mechanical, electrical, or electronic contrivance with a specific purpose.
device server: An object within a logical unit that executes SCSI tasks according to the rules of task management.
device service request: A request, submitted by an application client, conveying an SCSI command to a device server.
device slot: A position into which an SCSI device may be inserted in an enclosure. The position provides appropriate power, signal, and control connections to the SCSI device. The position may also provide mechanical protection, locking capability, automatic insertion, visual device status indicators, and other features to manage the SCSI device in the enclosure.
device type: The type of device (or device model) implemented by the device server.
element: An object related to an enclosure. The object can be controlled, interrogated, or described by the enclosure services process. Defined elements are: **devices; power supplies; cooling elements; temperature sensors; door locks; audible alarms; enclosure services electronics; SCC electronics; nonvolatile cache; UPS; display; keypad; SCSI transceivers; language element; communication port; voltage; current; SCSI targets; SCSI initiators; and vendor-specific fields.**
enclosure: The box, rack, or set of boxes providing the powering, cooling, mechanical protection, and external electronic interfaces for one or more SCSI devices.
enclosure services: Those services that establish the mechanical environment, electrical environment, and external indicators and controls for the proper operation and maintenance of devices within an enclosure.
enclosure services device: An SCSI device that monitors and controls enclosure services.
enclosure services process: The object that manages and implements the enclosure services. For an enclosure services device the enclosure services process also implements the device server.
enclosure services processor: The physical entity that implements the enclosure services process.
information condition: An enclosure condition that should be made known to the application client. The condition is not an error and does not reduce the capabilities of the devices in the enclosure.
indicator: A machine readable bit that optionally generates an externally visible indication when set.
initiator: An SCSI device containing application clients that originate device service requests to be processed by device servers.
logical unit: A target-resident entity which implements a device model and executes SCSI commands originated by an application client.
non critical condition: An enclosure condition established when one or more elements inside the enclosure have failed or are operating outside of their specifications. The failure of the elements does not affect continued normal operation of the enclosure. All SCSI devices in the enclosure continue to operate according to their specifications. The ability of the devices to operate correctly if additional failures occur may be reduced by a non critical condition.
redundancy: The presence in an enclosure of one or more elements capable of automatically taking over the functions of an element that has failed.
SCSI device: A device that may be connected to a service delivery subsystem and supports an SCSI application protocol.
target: An SCSI device that receives SCSI commands and directs such commands to one or more logical units for execution.
unit attention condition: A state that a logical unit maintains while it has asynchronous status information to report to one or more initiators.
unrecoverable condition: An enclosure condition established when one or more elements inside the enclosure have failed and have disabled some functions of the enclosure. The enclosure may be incapable of recovering or bypassing the failure and will require repairs to correct the condition.

4.5 Configuring SNIA HBA API Library

The **SNIA Common HBA API** library was added to SMARTMon-UX in release 1.23. The library is an industry standard library used to manage Fibre Channel Host Bus Adapters and discover SAN resources. It was developed through the Storage Networking Industry Association (SNIA).

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This library is supported by Q-Logic, Emulex, JNI, and other manufacturers of Fibre Channel HBAs as well as the major computer manufacturers such as Sun and HP. The library is safe to run from the perspective that it does not allow you to make any changes to anything on the SAN that can only be addressed through the SNIA drivers. That is, if your system is physically attached to disks on the SAN, and your HBA and optional switches are zoned such that a particular device can be accessed by your host computer, you will be able to make changes to it using the standard commands and options that have always been in SMARTMonUX. If your system is not authorized by your administrators to access a particular device, you will be able to see basic information about it using the **SNIA functions**, but you will not be allowed to do anything else.

For example, suppose you have a LUN at WWN port number 20:00:00:99:88:AB:CD:EF and another at 20:00:00:99:88:AB:CD:F0. Both LUNs are attached to the HBA in this machine, but you configured your RAID engine or switch to prevent you from mounting the second (... CD:F0) device. Our software would still let you see that the second device existed and report information about it. It would not allow you to change mode pages for the device. That is because the SNIA HBA API library was designed to prevent this for security reasons.

In general, the official SNIA web describes the API as:

"It defines a scope within which application software can be written without attention to vendor-specific infrastructure behavior. Included within the scope of the Common HBA API are vendor independent interfaces and services such as:

- ***Observation and modification of descriptive and operational characteristics of Fibre Channel HBAs and ports;***
- ***Access to Fibre Channel Fabric Services;***
- ***Discovery and characterization of FCP-2 storage resources;***
- ***Access to Fibre Channel Extended Link Services sufficient to satisfy the FC-MI manageability profile for Host Bus Adapters;***
- ***Observation of Fibre Channel HBA, Port, and storage access traffic statistics;***
- ***Observation and modification of the availability and representation of Fibre Channel storage resources to Operating System applications;***
- ***Timely and selective reporting of HBA and fabric configuration, status, and statistical events."***

This HBA API is distributed as a runtime file specific to your operating system and your HBA. They are all available for download on your particular HBA vendor's web site and are typically bundled with the fibre channel device driver.

Below is the official HBA API FAQ. We removed some geeky parts only applicable to developers, reformatted, and appended SANtools-specific information on our implementation in ***RED***.

HBA API FAQ

1. Introduction

This FAQ is intended to address frequently asked questions about the HBA API. This FAQ is maintained by Benjamin F. Kuo at TROIKA Networks, Inc. <benk@troikanetworks.com> and Dixon Hutchinson at Legato Systems, Inc. < dhutchin@legato.com> and is not endorsed or sponsored by the Storage Networking Industry Association (SNIA).

2. What's New

A little more information on iSCSI API's and the support Matrix.
Version history:

Version	Date	Description
1.0.0	June 29, 2001	Initial Draft
1.0.1	July 10, 2001	Resolved initial comments, added support matrix
1.0.2	August 16, 2001	Reformat, remove copyright
1.0.3 - 1. 0.7	September 15, 2001 - January 30, 2002	Update vendor support matrix

3. General Questions

3.1. What is the HBA API?

The SNIA Common HBA API is an industry standard, programming interface for accessing management information

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in Fibre Channel Host Bus Adapters (HBA). Developed through the Storage Networking Industry Association (SNIA), the HBA API has been overwhelmingly adopted by Storage Area Network vendors to help manage, monitor, and deploy storage area networks in an interoperable way.

The HBA API is implemented as a set of 'C' level API's which allow access to low level, Fibre Channel HBA information in a platform- and vendor- independent way. The API depends on vendor supplied, vendor specific code for the vendor's HBAs. The API does not support any vendor's HBA without a vendor specific library.

3.2. What is the history of the HBA API?

The HBA API effort began in March of 2000 in the SNIA Fibre Channel working group. In May of 2000, the HBA API subgroup was formed. In July of 2000 the 1.0 feature set was frozen and the initial draft submitted to the T11 FC-MI standards group. Version 1.0 was approved by the SNIA Fibre Channel working group in September of 2000 and is currently undergoing review as part of the T11 FC-MI Letter Ballot process. Version 2.0 efforts have been ongoing since December of 2000, with version 2.0 expected by Q2 2002.

3.3. How real is this standard? Specifically, when can I see this working?

The HBA API is in deployment today and was first demonstrated at the Fall 2000 Storage Networking World in Orlando. (Most, if not all FC HBAs now support the API, but not for all operating systems).

3.4. Is the HBA API an in-band or out-of-band mechanism?

The HBA API is neither. Information from the HBA API can be **usually found through an out-of-band mechanism for management, however can also be accessed in-band through a IP over Fibre Channel connection.**

3.5. Does the HBA API support SCSI adapters?

No, the HBA API is limited to supporting Fibre Channel HBAs.

3.6. Does the HBA API support iSCSI adapters?

Not yet, however there has been discussion on adding iSCSI support in the future. There is a separate working group (IPS TWG) within SNIA working on an API for iSCSI.

3.7. How secure is the HBA API? Can a rogue program disrupt my SAN through the HBA API?

There are no calls in the current HBA API which are able to read or write data from storage or otherwise affect SAN operation. All current SCSI calls in the HBA API are informational (read-only) calls. However, the CT pass through command does allow read and write of information from a switch, if allowed.

4. Installation and Usage

The HBA API is implemented as a common library which depends on vendor-specific libraries for specific HBA model support.

4.1. What files are installed to use the HBA API?

The HBA API consists of three major parts (vendor library, common library, and registration) that are installed on a system to operate.

- ***On Windows systems:***
  - HBAAPI.DLL is the common library, installed in %SYSTEMROOT%/SYSTEM32.
  - The vendor install software will write a registry entry in HKEY_LOCAL_MACHINE\Software\SNIA with the location of the vendor-specific library.
  - Vendors will install a vendor library, typically in the same location the vendor stores their driver software.
- ***On Unix systems:***
  - libHBAAPI.so is the common library, installed in /usr/lib for 32-bit systems, and the appropriate 64-bit library locations depending on operating system.
  - The vendor install software will write a line to /etc/hba.conf with the location of their vendor-specific library.
  - Vendors will install a vendor library, typically in the same location the vendor stores their driver software.

4.2. Where does the HBA API common library get installed?

- On Windows systems:
  - **`HBAAPI.DLL`** is the common library, installed in %SYSTEMROOT%/SYSTEM32.

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- On Unix systems:
  - **`libHBAPAI.so`** is the common library, installed in /usr/lib for 32-bit systems, and the appropriate 64-bit library locations depending on operating system.
  - HP/UX (32-bit) links **`/opt/snia/api/lib/libHBAAPI.sl`** to /usr/lib
  - HP/UX (64-bit) links **`/opt/snia/api/lib/pa20_64/libHBAAPI.sl`** to /usr/lib
  - For LINUX32, LINUX64, and SPARC Solaris, we bundle our own HBA API library. Our installer will copy it to /usr/lib as **`libHBAAPISANtools.so`**. This was necessitated because we saw some inconsistencies between the API libraries bundled with Qlogic, Emulex, and JNI. If you have installed the manufacturer's standard libHBAAPI.so file, and running one of these operating systems, that library will be ignored. You must install the libHBAAPISANtools.so file in /usr/lib. No entries will be required in the /etc/hba.conf file. If you have another application running that uses the standard libHBAAPI runtime, it is not supposed to conflict. If you discover an application that results in a conflict, please let us know.

4.3. Can I issue any arbitrary SCSI command with the HBA API?
No. The scope of the HBA API is limited to discovery of Fibre Channel components. Generic SCSI pass through has been discussed, but has been deemed generally dangerous, as it bypasses the operating system protections and also causes several SCSI-related issues (including problems with breaking reservations, potentially corrupting data, or interrupting I/O). As such it is not included in the API.

4.4. What is the difference between a platform WWN and a node WWN?
- **platform WWN** - unique world-wide identifier for a computer system used to tie together in software the association between many components within that system
- **node WWN** - unique world-wide identifier used to associate many port world wide names within a system. This is used currently in two ways: first, to specify the relationship between ports on a common device (one node WWN and several port WWNs on a HBA), secondly to identify ports on a system (one node WWN and many port WWNs on a system with many HBAs). Unfortunately the use of this is not consistent within currently deployed hardware.

4.5. What is persistent binding?
Persistent binding is a feature of HBAs which remembers the last SCSI address a particular Fibre Channel target has been mapped to. For example, that a port on a physical disk (world wide name 01:02:03:04:05:06:07, LUN 0) was last seen at SCSI address (bus=0,target=3,lun=0) on the operating system. Persistent binding ensures that this is consistent from reboot to reboot unless changed by the user.

Some HBA vendors automatically persistently bind devices, while others require manual configuration. Persistent binding is most important in the case of operating systems which remember devices by SCSI address or in the case of raw volumes used by databases.

5. Development Questions
5.1 What is the common HBA library?
The common library is a component of the HBA API, typically called HBAAPI.DLL or libHBAAPI.so which loads vendor specific library support for HBAs. ***(This library is specific to an operating system and is supposed to be bundled with the HBA API drivers supplied by your controller vendor. If that is not the case, please let both your HBA vendor know about this, as well as SANtools so we may work with your HBA vendor to supply the proper files and get them tested.)***

5.2 What operating systems are supported by the HBA API common library?
The initial work on the HBA API was done on Windows NT, Windows 2000, and Solaris 2.6, 2.7, and 2.8. Other operating systems are also planned for support. ***(SPARC Solaris 7-9, Windows 2000/XP/2003, HPUX, and LINUX are available. Other operating systems may have them as well, but are not supported by SMARTMon-UX.)***

5.3 Does the HBA API support asynchronous event notification?
Version 1.0 of the spec does not support asynchronous event notification, however this capability is a central part of Version 2.0 of the spec.

5.4 What is the maximum buffer size that can be passed to the common HBA function HBA_SendCTPassThru?
This is a vendor specific limitation and depends on the vendor of your HBA. (It does not matter, we do not use this

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function call ... yet).

5.5 Why was the HBA_ResetStatistics call removed?
The HBA_ResetStatistics call was removed because it was decided that resetting statistics counters is an undesirable function. Because any application accessing the HBA API could reset statistics, this could potentially confuse other software monitoring statistics counters. ***(We did not implement this feature for obvious reasons).***

6. Resources
6.1 Who is behind the HBA API standard?
During the first Storage Networking World conference with the HBA API demo the following vendors endorsed the HBA API Interoperability Theme: Adaptec, Agilent, BMC Software, Brocade, Connex, EMC, Emulex, FCIA, FibreAlliance, HP, Highground, Hitachi Data Systems, Interphase, InterSAN, JNI, Legato, McData, NCITS, Prisa, Qlogic, StorageNetworks, SNIA, Tivoli, TROIKA Networks, Veritas, and Vixel. Other vendors also have announced their support since that time.

6.2 What HBA vendors support the HBA API?
Agilent, Emulex, Interphase, JNI, and Qlogic, TROIKA Networks have all publicly announced their support for the HBA API. You should check with your individual vendor if they are not listed here.

6.3 Which HBA manufacturers/models have HBA API libraries available?
Below is just a subset of manufacturers and models which have downloadable SNIA libraries. You should check with your hardware vendor for current drivers and runtimes.

Vendor Name	HBA	Supported O/S	Contact
Emulex	Almost all	Windows, Solaris, LINUX	http://www.emulex.com
JNI	Almost all	Windows, Solaris, LINUX	http://www.jni.com/Drivers
LSI Logic	Almost all	Windows, Solaris, LINUX	http://adapters.lsilogic.com
TROIKA Networks	Zentai Z-2400+	Windows	http://www.troikanetworks.com
Qlogic Corp	QLA2100+	Windows, Solaris, LINUX	http://www.qlogic.com
ATTO Technology	ExpressPCI FC 3300 ExpressPCI FC 3305 ExpressPCI FC 2600 ExpressPCI FCSW *(and more)*	Windows	http://www.attotech.com/software
Agilent Technologies	HHBA-5101C HHBA-5121A HHBA-5221A HHBA-5220A	Windows	http://www.agilent.com
Hewlett-Packard	All Tachyon HBAs, rev B.11.00.10 or higher (except A3591B, A3404A, A3636A, A3740A)	HPUX 10.1 and above	HP Support (they are bundled with HPUX and the HBA cards) and available through the registered support site. They are also part of the standard HPUX 11.0 and above O/S distribution CDROMs, and are pre-loaded on all systems.

SANtools-specific
7.1. What happens if the HBA API runtime is not installed on this system?
If you run the software with either the `-fc` 128, `-fcping` 140, or any other option that starts with "fc", the software will just report that there are non SNIA-supported HBAs attached to your system. All of the other functionality relating to direct-attached fibre channel devices will be unaffected.

7.2. What if I have more than one make and/or model of HBA in my system?

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Everything. It works just fine, provided all of the adapter-specific drivers are properly installed and configured. If they are not, then the software simply will not report anything for the adapters that do not have the library files installed.

7.3 Where are the configuration files stored on my UNIX/LINUX machine.
The runtime library files are ordinarily stored in **`/usr/lib`**. The file, **`/etc/hba.conf`** instructs the library how to cross-reference the description of the card with the specific library file. See the below example:

```
# contents of file /etc/hba.conf
#
# This file contains names and references to HBA libraries
#
# Format:
#
# <library name>  <library pathname>
#
# The library name should be pre pended with the domain of
# the manufacturer or driver author.
org.snia.sample32          /usr/lib/libsample.so
com.jni.fibrestar32        /usr/lib/libhbaapijni.so
com.qlogic.qla32           /usr/lib/libhbaapiqla.so
com.emulex.lightpulse32    /usr/lib/libhbaapiemu.so
com.jni.fibrestar64        /usr/lib/sparcv9/libhbaapijni.so
com.emulex.lightpulse64    /usr/lib/sparcv9/libhbaapiemu.so
```

7.3 Where are the configuration files stored on my Windows-family PC?
Registry entries are made to provide the windows-specific implementation of the /etc/hba.conf file. The HBA library installers created by all the HBA vendors automatically do this for you. They are also supposed to append additional entries for other HBAs as needed.

4.6 Windows Device Naming Conventions

With the advent of release 1.25, we believe we have introduced a better solution to problems unique to the Windows family operating systems and device naming conventions. Specifically, the operating system does not always assign the same physical device name to a device on every boot-up, particularly with fibre channel disks on a SAN. If you have devices such as SCSI processors (I.e., RAID controllers) or SES processors, it will assign a device such as **\\.\SCSI2** to all devices on the same SCSI controller. The convention is only applicable to devices which use the SCSI interface, which would include fibre channel peripherals and SCSI processors and enclosures. The change was necessitated by Microsoft's new STORPORT drivers which have a slightly different mechanism for direct I/O.

What we have done is added a second naming convention for physical devices which should be much more constant between reboots and hot plugging and unplugging storage. The program will still recognize device names such as **\\.\PHYSICALDRIVE3** or **\\.\SCSI2**, and will work as before with those device names for compatibility purposes. However, you can now address devices by a more descriptive name that ties the device name to the hardware paths, rather than some pseudo-randomly defined order based on when the O/S discovers a device.

The new device names take the format **\\.\SCSIaPortbPathcTargetdLune** where letters **a**,**b**,**c**,**d**, and **e** represent the hardware paths which tend to stay constant, even in a SAN environment were devices could be inserted or removed for the SAN at any time. The program will still support the older \\.\PHYSICALDRIVEn format if you care to use it, but the software will always default to the \\.\SCSI type format if you do not specifically put in a device path which instructs SMARTMonUX to scan for devices.

Determining Device Names
The best way to see both formats of device names for your peripherals is to enter smartmon-ux -l from the command line. By not supplying a list of devices, the software will scan for everything it can discover. By design, it also creates a scratch file, called FileList.txt which will be saved in the current directory.

On this machine, if we type out FileList.txt, we see ...
\\.\SCSI2Port2Path0Target4Lun0 path=0 port=2 id=4 lun=0 type=0 [SEAGATE] [ST336753FC] [0002] \\.\SCSI2Port2Path0Target4Lun0

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```
\\.\SCSI2Port2Path0Target5Lun0 path=0 port=2 id=5 lun=0 type=0 [SEAGATE ] [ST336605FC     ] [0003] \\.\SCSI2Port2Path0Target5Lun0
\\.\SCSI2Port2Path0Target6Lun0 path=0 port=2 id=6 lun=0 type=0 [SEAGATE ] [ST336753FC     ] [0002] \\.\SCSI2Port2Path0Target6Lun0
\\.\SCSI2Port2Path0Target16Lun0 path=0 port=2 id=16 lun=0 type=0 [SEAGATE ] [ST336605FC     ] [0003]
\\.\SCSI2Port2Path0Target16Lun0
\\.\SCSI2Port2Path0Target18Lun0 path=0 port=2 id=18 lun=0 type=0 [SEAGATE ] [ST336605FC     ] [0003]
\\.\SCSI2Port2Path0Target18Lun0
\\.\SCSI2Port2Path0Target19Lun0 path=0 port=2 id=19 lun=0 type=0 [SEAGATE ] [ST336605FC     ] [0003]
\\.\SCSI2Port2Path0Target19Lun0
\\.\PHYSICALDRIVE1 path=0 port=2 id=4 lun=0 type=0 [SEAGATE ] [ST336753FC     ] [0002]
\\.\PHYSICALDRIVE2 path=0 port=2 id=5 lun=0 type=0 [SEAGATE ] [ST336605FC     ] [0003]
\\.\PHYSICALDRIVE3 path=0 port=2 id=6 lun=0 type=0 [SEAGATE ] [ST336753FC     ] [0002]
\\.\PHYSICALDRIVE4 path=0 port=2 id=16 lun=0 type=0 [SEAGATE ] [ST336605FC     ] [0003]
\\.\PHYSICALDRIVE5 path=0 port=2 id=18 lun=0 type=0 [SEAGATE ] [ST336605FC     ] [0003]
\\.\PHYSICALDRIVE6 path=0 port=2 id=19 lun=0 type=0 [SEAGATE ] [ST336605FC     ] [0003]
\\.\CDROM0 path=0 port=1 id=0 lun=0 type=5 [HL-DT-ST] [DVD-ROM GDR8081N] [0110]
```

By comparing the values for the path, port, id, and lun, we can see that **\\.\PHYSICALDRIVE1** maps to the same device as **\\.\SCSI2Port2Path0Target4Lun0**. Therefore, both device driver names can be used interchangeably throughout the program.

However, we advise using the **\\.\SCSI** type device name format since this is tied to the physical path, where the **\\.\PHYSICALDRIVE** format is assigned by the O/S in whatever order it wants to. If you add another controller to your system, or add/remove a device, the **\\.\PHYSICALDRIVE** type driver may change for any or all of your peripherals.

Removing Duplicate Entries

SMARTMonUX will ALWAYS scan for devices when you invoke it, in order to provide support for both device names, and to insure that scripts that do not specify particular devices will not execute on the same device twice with both device names. The default device name will always be the **\\.\SCSI** type device.

4.7 Update Revision History

Version 1.43 (Released DEC 2009)

- Increased maximum block count for -scrub family commands from 112 to 120 blocks (which results in slightly faster scrubbing and DVT testing)
- Added support for Newisysvi l 2240 and 2241 SES enclosures
- Added full support for disk scrubbing, verification, -read, and DVT tests when disks formatted to 520 or more bytes per block. (The -read 103 command would return an error message unless the disk was formatted to 512 bytes per block)
- Enumerates vendor-specific health information for STEC Solid-State Disk SSD products (End-to-end errors, aborted commands, uncorrectable errors, and more)
- Fixed problem on some Infortrend RAID controllers where firmware revision was displayed as numeric information rather than text string.
- Program now properly reports serial number for Intel's SSR212MC storage appliances.
- You can now upgrade SES firmware on Intel's SSR212MC appliances, as well as Newisys SAS/SATA 2240 and 2241 enclosures.
- Added 5 newly-defined ANSI TapeAlert codes defined in 2009
- Increased timeouts for issuing the -read command in situation where device might be spun down. (Now it is 30 seconds)
-

Version 1.42 (Released NOV 2009)

- Fixed buffer over run if reporting on a 10Gbit FC disk
- Added support for AIX 5.3
- Added new self-tests for ATA/SATA disks (windows only, limited MAC 10.5+ support), and allow use of all self tests on all SCSI, FC, SAS peripherals, rather than disk drives only. (**`-stefa, -steba, -stsba, -staa, -stra`**)
- 64-bit support for reading raw ATA disks greater than 2TB added
- Background low-level formatting **`-formatb`** and **`-formatconf`** to suppress are-you-sure message added. In addition **`-random`** added to randomize data.
- Support for enumerating all peripherals updated to latest SATA 3.0 specifications and SCSI specifications, resulting

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in reporting several hundred new fields)
- Major enhancement to LSI internal RAID logic to support SAS-2 peripherals and next generation of API.
- Added email-reporting to Infortrend hardware that is being monitored
- Increased sizes of pass-through to prevent truncating log pages > approx 60KB.
- Added vendor-unique enumeration and reporting for several dozen new disk drives, SES enclosures and tape drives. See -V+ 166 option for latest list.
- Removed need for scratch file during enumeration, which prevents multiple instances in same directory from conflicting with each other when they run concurrently. Scratch files now stay in RAM as needed and are automatically purged when the program terminates.
- Added new option **-M** in threshold monitoring for monitoring and reporting values on polling period
- The **-F 0** option to perform SMART poll once and exit was previously limited to windows, now it works on all operating systems.
- Added support for HP's VMS / OpenVMS [Via a restricted reseller channel]
- Significantly improved performance of all -secure erase tests, and self-tests, they run as much as 3 times faster.
- Enhanced NIC-based licensing so it no longer keys off of first ethernet controller.
- Fixed problem enumerating HP MAS70 and Newisys SES enclosures by increasing a buffer size. Added SES command to control drive ID bay LEDs.
- Added -sqq option to suppress all logging
- Added **-HEALTH** and **-HEALTHFULL** options
- Added several options for media verification **-verify**

Version 1.39 (Released OCT 2008)
- Added additional reporting capability for LSI-family embedded and PCI-based RAID and JBOD controllers (Board information; enumeration of RAID configuration; reformatted output to make it easier to understand; report serial numbers of individual drives.
- Added **-zdq** parameter for reporting just disk drives behind LSI-family embedded and PCI-based RAID controllers
- Added **-flashses7** command, originally added to SPARC-Solaris version 1.38 only to all operating systems.
- Additional fields to enumerate health and configuration of LSI-family external RAID subsystems was added.
- The **-zd** 213 family of commands now report the physical device name that the operating system assigns to physical and logical disks. If a disk is part of a RAID configuration, it will report bus and target information only.

Version 1.38 (Released SEP 2008)
- Added **-flashses7** command for flashing SES enclosures that require "type 7" firmware updates. (LSI SAS Shea enclosures, for example)
- (This is an interim build that served as a test revision until the **-flashses7** was fully tested)

Version 1.37 (Released JUN 2008)
- 64-Bit HP/UX added
- The **-flash** 47 command no longer limits itself to disk drives. If the target device is SCSI, SAS, or Fibre Channel, and it supports the ANSI-standard firmware flashing mechanism, then the command will allow firmware to be flashed to any device type.
- Added **-flashses** command to flash new SES firmware on supported enclosures
- Support for SES / enclosure management added for Intel SSR212MC systems which are OEMed by numerous vendors (such as the HS-1235E by Xyratex)
- Fixed problem that caused program to crash if there was a 3WARE controller configured without any disks and user sent command to enumerate the configuration.
- Program now traps kill, quit, CTRL-C commands/keystrokes, and exits with the ABORTEDBYUSER 7 return code 22 and displays appropriate message depending on whether user terminated the program or it was terminated by the operator. It now also insures that all scratch files are deleted when program is aborted by user.

Version 1.36 (Released May 2008)
- Added a series of commands to spin SCSI/FC/SAS disks up (**-spinup** 127), down, and to query spin status
- Added **-EPL** 37 family of SES commands to support LSI Shea enclosures, as well as other enclosures that report array devices
- LSI Shea SAS family enclosures now report vendor-unique configuration fields

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- All Seagate SAS family disks as of this date added to vendor-specific database
- Additional SATA/ATA-8 commands added to enumerated error list and inquiry version fields
- Additional vendor-specific SMART fields enumerated for Maxtor, Fujitsu, and Seagate SATA disks
- Significantly more information reported for LSI MPT-family RAID controllers (seen in HP, Dell, IBM and other systems)
- **-bmsr** 217 command that reports background scanning results enhanced with additional output
- Support for LSI MPT-family RAID 213 controllers added to SPARC Solaris version
- The **-O** 74 command now works in Windows platform
- Additional return codes 7 added
- (Version 1.36B, released June 2008, adds support for Intel Storage Servers)
- Added additional vendor-specific SATA S.M.A.R.T. entries

Version 1.35 (Released Dec 2007)

- Propagated increased SCSI pass-through buffer enhancement introduced in 1.34 to all LINUX variants
- Added commands to support DELL (LSI) family RAID controllers (**-zd**) (**-zdd**) (**-zdL**)
- Corrected total number of blocks on disk drive as shown on drive testing summary, quantity was last block number instead of total number of blocks.
- (Enhanced random number generator for secure erase .. it now uses cryptographic-quality ISAAC random number generator, and EVERY bit is randomized, not just a 16KB repeating pattern throughout the disk.
- Added new return code (12) for secure erase test, used to indicate that data on disk is not random
- SATA/ATA device support improved for SPARC Solaris, full ATA Identification report now generated
- ANSI-standard fields for ATA-8 class devices now enumerated
- Additional fields specific to 3WARE/AMCC 9x00 RAID controllers running firmware released after JUN 2007 added
- New function (-z3m) that dumps 3WARE/AMCC RAID controller event logs added
- Windows 2008 & Vista support added (For X86, IA64, and X86_64 architectures)
- Mac OSX 10.5 support for both Power PC & Intel architectures added
- **-securecheck** 111 and **-securecheckall** 111 functions added to Secure Erase
- Secure erase support added for SATA/ATA disks
- Program now reports device make/model as part of low-level format Are-you-sure message
- **-Cx** 66 command to and/or suppress limitations to field size masks
- Windows-family EMAIL engine now supports -Port command which facilitates setting a non-standard SMTP port to mail server
- ***- Secure erase logic now completes the random I/O phase significantly faster, now it takes only 25% more time then***
- ***the all-ones or all-zeros phase, instead of taking almost 3 X as long.***

Version 1.34 (Released Oct 2007)

- (Windows-only) Increased size of SCSI pass-thru buffer from 32K to 64K to support certain vendor-unique log pages,
- Approx 100 additional reportable fields applicable to Engenio (LSI) external RAID engines added
- Added additional inquiry data reporting specific to SATA disks attached to SAS/SATA controllers (SAT protocol)
- Windows version now utilizes single executable that works for systems that do not have SNIA FC drivers installed (Previous releases were distributed with 2 separate executables)
- Background media scanning commands added (-bmsd) (-bmse) (-bmsr)

Version 1.33 (Released Jul 2007)

- X86_64 LINUX build released
- Reporting & configuring background media scans added
- Additional vendor-unique log pages added
- (Windows-only) temporary files for windows versions are now saved in user-specific temp file directory instead of executable's directory.
- (Non-Windows) temp files now start with /tmp/santoolsXXXXXX rather than /tmp/junkXXXXXX
- MAC-address based licensing added for Windows family versions
- Background initialization sub page now reported
- ANSI SES-page A now reported

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- Additional mode page fields (EER, ACC, TPGS) added
- SAS protocol log page now reported when log pages are queried
- NAA IEEE ID now reported with -I+ 53 option
- AIX 5.X SCSI passthrough support added
- Approx 50 new SCSI sense code text messages added
- Vendor-unique fields for Xyratex 1603 (SAS / SATA EBOD) enclosures added

Version 1.32 (Released Dec 2006)

- New feature, -capacitybs 28 added which will change block size (you would primarily use this to change disks formatted at 520 bytes/block to 512 or vise-versa.
- The program decodes new SATA/ATA-7 ANSI descriptors introduced since 2006
- Changed error message on -mpimport 95 if option invoked with invalid parameters.

Version 1.31 (Released Mar 2006)

- -wsc 125 option added, so a write same test will optionally terminate on first error
- Numerous enhancements added to support disks speaking SAT protocol. This includes adding additional error messages and decoding protocol-specific EVPD inquiry and log pages.
- The -confirm 125 flag is now also supported on the write-same commands
- Program now decodes information for new scsi device types (bridge, OSD, ADC, logical units) and protocol flags (dozens of new entries) for devices (up to SPC-4)
- -H+ 68 and -C+ 68 flags added to support devices which do not properly decode log page 0.
- If a direct access device reports zero blocks then this is no longer reported as an error.
- Approx 50 new ANSI sense messages are now decoded.
- EVPD page 89 is now reported for SAT devices
- QUALSTAR tapes now added to decoded list
- Returns "Can not determine device size" rather than 0 if disk drive reports invalid size.
- Decodes new ANSI fields in Mode page 10.
- Added ST314685SS, ST3146854SS, S373454SS, ST33675SS, ST973401SS, ST936701SS SAS disks to database.
- Enhanced the tables that describe ANSI compliance levels for all SCSI family peripherals, so all entries are returned with the +I rather than the interface information.
- Updated SMART tables for Fujitsu family disks
- Addressed bug specific to Adaptec 29120AS adapters on windows that caused program to crash when performing SCSI inquiry.
- Program now partially reports slot information for Xyratex Sumo family enclosures.
- The drive fitness test warning screen now returns make/model information of the selected disk drive.
- Fixed "parametrs" typo when windows version launches as a service.
- Added -secure 111 function for DoD secure erase for SCSI, SAS, Fibre channel disks
- Fixed LINUX-specific bug that would crash program if run w/o ANY options and the system did not have any ATA disks.
- LINUX version might report 0 defects, if there are approx 1500 or more defects. This logic now works as long as LINUX kernel supports 12 and 16-byte SCSI commands (2.6 or higher).

Version 1.30 (Released Dec 2005)

- Decoded additional vendor-unique S.M.A.R.T. descriptions for Recovered ECC error on non-Hitachi disk drives.
- Decoded newer ATA/SATA disk identifiers introduced in ATA/SATA-7 ANSI specifications.
- Program no longer displays block of zeros if a S.M.A.R.T.-compliant disk does not return S.M.A.R.T. data when told to do so. (This happens in event of a hardware problem with a disk).
- Added support for HP/UX on Itanium hardware
- Prevented problem where a certain vendor repackages an 3Ware (AMCC) 210 controller and the software did dot detect this, so enhanced functionality was not available to those logical disks.
- Now reports invalid option message rather than crashing program if -G 157 option is not followed by a temperature value, or -mail 8 command is not used with proper attributes.
- E-Mail alerts under windows now additionally report IP-based host and domain and name of client PC that generated the alert.

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- The program no longer accepts invalid options for the -mail 8 command, and provides appropriate warning.
- -ZM 201 option (Mylex-engine-specific) now reports a SAN Mapping table
- -z3d 212 option to report 3Ware internal controller diagnostic dump was added.
- -z3L 213 option to report 3Ware internal controller event log was added.
- New fields were added to the -I+ 54 dump for 3Ware (AMCC) 210 controllers (these include cache policies, battery information, A/V mode and several others)
- The drive fitness tests now have a user-defined option that allows the tests to terminate on the ***first*** error, rather than requiring them to complete.
- The WWN now prints on all fibre channel disk drives rather than Seagate disks (with the -I+ 54 option).
- Made several cosmetic changes to usage information returned by the -help 18 command
- -capacity 28 command added that changes reported/usable drive capacity on SCSI, FC, & SAS disks.
- -confirm 17 option added to most destructive (and potentially destructive) commands that normally ask an are-you-sure message
- A "Total Capacity (in bytes)" line was added to the inquiry dumps (-I 53 and -I+ 54)
- The Windows 9.3 driver update for 3Ware (AMCC) was not compatible with this software so the software did not recognize any of their RAID controllers. This new build incorporates a revised library that resolves the problem.
- 3ware (AMCC) support 210 has been added to the IA64 LINUX & Windows.

Version 1.29 (Released Aug 2005)

- Added auto-launch program capability in event of a predictive drive failure (the **-LB** 13 command).
- Added standardized return-codes 7 to facilitate in using SMARTMon-UX in script files.
- Additional scrub family drive fitness tests 118 added.
- Disk firmware flashing support for full family of Fujitsu SCSI and Fibre channel disks added.
- The windows version can now run as a native Windows service routine 14.
- Infortrend RAID reporting now reports IP settings for the controller.
- Drive firmware flashing logic increases chunk size on non-LINUX platforms in order to marginally speed up drive flashing process.
- The software now allows you to test predictive failure actions by using the **-T** 11 flag in combination with sending out emails, generating event log messages and launching predictive failure scripts 12. Previously, the -T flag could only be used to send out a test message via email.
- Added the **-sq** 21 option which suppresses logging of successful polling messages in the event log specified by other command-line options.
- Added the **-scrubt** 121 command to terminate self tests upon first error found.
- In order to support running as a service, the windows release was compiled as a threaded application. This has a negligible affect on performance.

Version 1.28X (Latest patches released since June 2005)

- Added the **-rc** 31 command that corrupts blocks to deal with vendor-specific Reverse ECC capability found in Seagate Cheetah 7 family disks and fixed the problem that prevented the Windows family version of the program from issuing the command properly.
- Setting the polling frequency to 0 (**-F 0** 18) instructs the program to poll SMART once then exit.
- Removed terminating line feed character from event log messages (applicable to Windows version only).
- Added 80+ additional vendor-unique entries for Fujitsu MAT family disks and HP C7438A tapes & autochangers.
- New windows-specific **-Mail** 8 flag for configuring mail servers that require authentication.

Version 1.28 (Released Apr 2005)

- Limited support for ATA disk drives on Apple OS X and SPARC Solaris. The devices cannot yet be polled, but the detailed configuration information can be reported with the **-I** 53**.**
- Several typos introduced with new functionality were fixed.
- Added subsystems which can be used to detect if a device fails or is removed.
- Logic added to support OS X ATA disks. (**-I** 57, **-I+** 54, **-O** 74, **-S** 72 options only. Program does not poll, but does enumerate devices and report serial number information).
- Fixed buffer overflow that would present itself with -fc option for HBAs that had events in event log where total text > 63 characters.
- **-fc** 128 command now translates FC-4 types into text (I.e., reports "Fabric services" or "Fibre channel services"

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instead of just a hex string

- If a disk had spun down, software would report "Disk not ready - skipping" when testing for SMART capability.
- If no disks are on the computer, and user wanted to monitor them, previous (UNIX/LINUX) releases would still respawn into the background. This no longer happens.
- (LINUX only) The program would terminate if run with **-I+** 54 option and the total number of defect information exceeded 0xfff8 bytes. (Approx 5000 defects). This was due to SCSI pass-through issue.
- New **-ping** 102 function added for background polling. This has slightly different message which reports serial number of removed disk. In the event the disk is returned, it reports that also. The **-ping** 102 option will NOT report a disk offline event every polling period if the device is not responding. It will only report first time it is missing, and when/if it is returned.
- Note: The software currently does NOT check to see if the returned disk has same serial number and make/model as one that was originally there. Many operating systems & drivers would prevent this from happening as they would assign a different device name, but this is not guaranteed.
- Demo versions of the program more aggressively detect evaluation timeouts.
- Modified logic that recognizes SGI TP9400 RAID subsystems that did not have all optional firmware features.
- Fixed problem with the **-rb** 104 (reassign blocks) command. The function reassigned block 1010101h.
- (LINUX only) The program now detects if your O/S does not support the READ_CAPACITY(16) command. As this command is only issued when the software detects a LUN > 2.1TB. This is more of a future-proofing since such RAID subsystems are quite rare, and only 2.6 kernel handles large LUNs by default.
- **-ping** 102 function for LINUX & IRIX can use wild-cards, as it will report missing devices for peripherals that match the string. If you -ping 102 /dev/sg[0-4], it will check /dev/sg0, sg1, sg2, sg3, sg4. It will check any device that exists in /dev which matches the search string.
- 8 new vendor-unique SMART registers have been decoded for Hitachi ATA/SATA disks.
- Previously, if a disk drive did NOT support SMART, but user added **-ping** 102 option to monitor, the device was skipped. Now if a non-SMART disk is monitored with **-ping** 102, it will still report if disk is removed or goes offline.
- Infortrend RAID logic trims extra blanks on Seagate disk drives when reporting with the **-zi** 208 option
- Fixed bug that prevented some vendor-unique log page data to appear in versions 1.27K through N.
- SAF-TE logic now reports Power on cycles, if supported by enclosure.
- Fixed potential buffer overflow if SAF-TE enclosure had more than 4 global flags which could result in program crashing.
- Fixed several bugs relating to SAF-TE reporting if the SAF-TE processor reported there were no fans or power supplies.
- SAF-TE logic incorrectly reported temperature in F / C conversion.
- SAF-TE reporting now decodes all device state bits, including combinations which are clearly invalid. (This was done to assist enclosure manufacturers when testing compliance).
- The **-E+** 33 flag which dumped full SES enclosure information and the **-EH** 33 flag that dumps the hex pages now work for SAF-TE enclosures.
- When viewing data that reports as hex dumps, some operating system libraries (Microsoft) had different interpretation of printable characters that displayed to the right of the hex bytes. The program now reports text for byte values 20h through and including 7E. Other bytes are printed as "." character.
- Significant rework being done to reporting IDE disk information, due to subtle constraints in IDE pass-through for various operating systems. Slight record layout changes are being made in attempt to standardize output which may be inconsistent across operating systems.
- Capacity shows in IDE disks on Discovery line.
- Additional fields are being displayed and decoded with **-S** 72 option for IDE (SATA / PATA) disks. This includes notes, decoded temperature, and total time used if available.
- Apple partition marker now identified with -Q option, and -Q option now supported on OS X.
- Suppressed reporting additional IDE information that is not applicable if disk does not support SMART.
- Discovery screen also reports if SMART was currently disabled or enabled on IDE disks.
- Mode page editor now accommodates hardware that does not accept changes unless the MODE SELECT command uses an 8-byte block descriptor. The program now retries the MODE-SELECT with 8-byte descriptor if the 0-byte descriptor fails.
- Support for 16-byte CDBs added. The -ws, -wsbyte, and -scrub family commands now optionally support them by just adding -16 to command line. Your O/S, drivers, firmware, and storage must all support such commands. If they do not, the program may not detect this condition.
- The Cache Optimization field specific to Infortrend-Family RAID controllers reported Sequential instead of

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RandomIO-optimized and vice-versa. This error has been fixed.
- Added cosmetic carriage-return after block scrubbing command completes so display shows 100% instead of 99% completed.
- The -scrubv and -scrubdiv commands now update percentage complete and time remaining more often than once every 1.0%. This helps those users that have created extremely large LUNs.
- SATA/PATA Drive temperature and cumulative power-on time now reported for several dozen more makes/models of disk drives.
- If you sent -S option to disk that did not support S.M.A.R.T., you previously got data with many zeros and spaces. Now you get appropriate not supported message.
- Support for ATA disk drives added to SPARC Solaris. This includes Polling, inquiry, and dumping of SMART information.
- Text reporting the HBA driver library & version no longer print at end of all -fc family commands. Now this prints with the "-fc" command.
- Suppressed reporting zeros & blanks for SMART-specific fields on disks that do not support SMART (-I+ option).
- Usable addressable sectors reported in CHS & LBA mode were byte swapped for ATA disks on -I option (but capacity in MB reported correctly).
- Per changes in revised ATA specification, the field TK0NF was relabeled NM in ATA disk error log dump (applicable to -O option).
- The -O (error log dump) was enhanced to decode op codes C7 & 2A.
- Support for the SNIA call, HBA_GetVendorLibraryAttributes has been removed. Not all HBAs support this function and information can be obtained elsewhere.
- SAF-TE now reports the SAF-TE optional slot status information, as well as speaker alarm status.
- Support for 3Ware/AMCC RAID engines added with -z3 and -z3x commands (LINUX & Windows only).
- Added Windows-specific fix that would have prevented an unclaimed device from appearing when it was attached to a multi-port fibre channel HBA.
- Added factory-default self-test (-stfd) option for SCSI/Fibre/SAS family devices.
- Added -EF flag which can be combined with -E+ and -EH commands that force discovery of SES pages that are not properly defined in SES page0 per ANSI Specs. This was added to deal with a non-compliant SES enclosure, and generally not required.
- The -zie option will now report and decode event logs for RAID subsystems using Infortrend-family RAID engines.
- Added -wce and -wcd to easily enable/disable write cache for SCSI/Fibre disks
- Fixed problem with UNIX/LINUX distributions where if -ping command was used. It sent device state to the console once program relaunched into background at every polling period. Now it only displays the status once to the console.

Version 1.27 (Released June 2004)
- The 64-bit LINUX build now supports SGI's 2.2 and 3.0 Pro Pack, as well as the 2.6 kernel. The 64-bit builds have also been tested on SuSE 9.0, Red Hat AS 2.1, Red Hat AS 3.0, and Red Hat 7.1 on Itanium-based processors. We do not anticipate there would be issues with any LINUX 32 or 64-bit variants with exception of AMD 64-bit platforms (which have not been tested as of this date).
- An IRIX-specific enhancement was added to dramatically improve performance of I/O specific diagnostics, such as the **-scrub** 118 family of commands. Now the program performs a maximum of 2MB worth of transfers before releasing the exclusive-only pass through subsystem, rather than opening the device, doing a single I/O, then releasing it.
- The **-I+** 53 (detailed inquiry) function now decodes data from extended vital product data inquiry fields (EVPD pages). 155 new fields were decoded for Seagate, Quantum, IBM and other vendor disk and tape drives.
- The **-I+** 53 function now reports basic controller information for Infortrend manufactured RAID engines.
- The **-V+** 166 function no longer appends the "(numeric)" suffix on fields that are numeric, as this is the default,
- The usage text (**-h and -?** 17) has expanded and re-arranged for better usability and clarity.
- The **-wsbyteconfirm** 126 command was added. This is same as the **-wsbyte** 125 command, only it does not ask you for an are-you-sure response.
- Data integrity tests, -scrubdiv and -scrubdi were added.
- Optional non-volatile SAF-TE enclosure fields for cumulative power-ons 34 and cumulative minutes 34 has been added.
- Optional SES vendor-unique type descriptors and element descriptors are reported, if the data is available for the selected SES enclosure.

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- Additional vendor-unique SES 40 fields for DotHill 43, Sun 41, LSI and IBM Pro Fibre 41, and Xyratex 45 enclosures are now reported.
- The total capacity for the selected device was reported as being one block less than it should be. Due to round off, we would not have expected this problem to be noticed unless your device had a number of blocks that was evenly divisible by 1000.
- A change was made to the UNIX/LINUX installer to make sure it is invoked from proper directory before it continues (otherwise the script fails).
- New data integrity check functions have been added.
- A bug was fixed in the 1.26 database that prevented several vendor-unique LOG page fields from being reported on Fujitsu and some HP tape drives and changers.
- The device name that appeared on the report when initiating self-tests might have displayed just the first part of the device name, i.e., \\.\SCSI2 instead of \\.\SCSI2Port2Path0Target17Lun0 depending on the device name and type.
- The -read function would sometimes fail in opening the desired disk or CD/DVD if it was a SCSI device, which caused the action to terminate with an error. This was seen under windows.
- The vendor-unique information for LSI RAID 201 engines now includes the 16-byte WWN 202 and fibre channel or SCSI host attach details 202 with the **-I+** option.
- Additional misspellings for topology, amendment, and several others were fixed. Some of these words appeared in the program executable.

Version 1.26 (Released April 2004)

- Syntax changes 68 were made to the self-test results (returned by **-str** 108 and **-C** 65) to incorporate additional information such as sense bytes and vendor-unique bytes (only in event of a failed-self test).
- Drive "scrubbing" commands, **-scrub** 120, **-scrubv** 121, and **-scrubq** 120 were added to perform block-level I/O testing.
- A command to reassign sectors **-rb** 104 was added.
- 35 New SCSI sense KEY/ASC/ASQ code table to bring sense key decoding to latest ANSI specifications. There are now approx 600 entries which are decoded. In addition, the program now uses a common pool of sense message strings reducing the program size.
- Typo fixed in sense key name miscompare.
- SMART-related 228 logic now attempts to set **MRIE** 228 bit to 6 instead of 4. This results in less overhead and system logging in event of a SMART error. (Note that if the disk does not support **MRIE** of 6, it will drop down to the next value, 4).
- Results from last 20 self-tests 108 shown instead of last 3 when calling the **-C** 65 option.
- Additional vendor-unique database entries brings total up to 1,412 entries.
- The WRITE SAME function **-wsbyte** 125 was added for initializing a SCSI class device with a user-defined pattern.

Version 1.25 (Released March 2004)

- Updated vendor-unique database for Hitachi fibre channel specific entries.
- Made significant modifications to the Windows-specific SCSI pass-through engine to properly discover fibre channel devices on JNI and selected Emulex LP9002 HBAs. The device discovery problem might also manifest itself with other controllers and drivers as well. See Device Naming Conventions 235 section for additional details.
- The device naming convention also required a modification in the syntax for threshold monitoring 158 files (Windows only).
- Resolved issue where unused device handles under windows were not being closed. The adverse affect was that the program wasted several KB of RAM.
- Introduced low level formatting capability for SCSI family disks with the **-format** 50 command, as well as a mechanism to clear grown defects and specify vendor-unique formatting parameters.
- Significant logic added to decode Xyratex-manufactured SBOD (firebird 40 family) enclosures via SES.
- Removed **HBA_GetVendorLibraryAttributes** SNIA call since this is not supported on many SNIA HBA API libraries.
- Firmware flashing function no longer tests to see if a disk is marked as "Seagate". This makes it possible to flash OEM firmware builds.

Version 1.24 (Released January 2004)

- International localization of date & time fields have been incorporated. Use the new **-i** 63 option to enable the feature (flag added to maintain output compatibility).

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- The HTML documentation now has a keyword index.
- **-r** 143 flag added to **-fciostat** 143 command to display raw totals for each statistic (instead of default changes over time).
- Minor change to installation script to fix error message that appeared under Solaris if the gnu tools were in the search path before /bin or /sbin.
- Fixed 32-bit overflow problem that would show incorrect disk drive capacity if total number of bytes on a disk drive greater than approx. 300 GB.

Version 1.23 (Released December 2003)

- Implemented support for SNIA HBA API. Currently added to LINUX, SPARC Solaris & Windows. Other O/S's will follow.
- Updated database to include additional vendor-unique entries for Seagate 146MB disk drives.
- Added HBA feature **-fc** 128 which does full dump of all HBA & SAN-related fields.
- Added HBA feature **-fcping** 140, equivalent to an Ethernet ping, but for a WWN port number and LUN.
- Reports approx 20 new fields relating to self-tests for IDE disks (Implemented in LINUX only - windows O/S does not allow this information to be reported).
- Reports following fields for ATA-3 type IDE disks (if not previously reported, and the disk supports reporting such data). Service interrupt, look-ahead, write cache, security mode, advanced power management, removable media notification, S.M.A.R.T. feature set, release interrupt, Max LBA in 48-bit mode (ATA-6+ disks only)
- Modified the installation script to correct problem preventing the script from working on 64-bit IRIX systems.
- Added support for reporting temperature on certain Maxtor disk drives (with +/- degrees C precision, if known).
- Reports up to 19 new vendor-unique Maxtor IDE S.M.A.R.T. threshold descriptions.
- Fixed problem with **-T** 16 option. Program did not terminate as documented.
- Capacity in MB field overflowed if the total blocks of LUN was >= FFFFFFFEh (2.1 TB). Program now supports 16-byte READ CAPACITY command.
- Expanded max size of SES-related reads to 4KB (prevented vendor-unique information in **-E+** 37 and **-EH** 37 SES dumps from appearing properly, but bug did not affect program's basic SES status reporting & alerting.
- Fixed non-compliant TapeAlert reporting capability discovered in Quantum DLT7000s. (Bug only affected TapeAlert Features reporting, not TapeAlert monitoring).
- Program now detects if log sense results exceed buffer size. Bug caused the hex dump feature to be of incorrect length.
- SES buffer size max on SES page 1 increased from 2048 to 4000 bytes (No problems with known encloses, did this for future-proofing).
- SES dump (**-E+**) now includes ASCII text from SES Help Text page, if supported by enclosure vendor.
- SES dump (**-E+**) now includes decoding of SES threshold page.
- Added logic to decode additional Vendor-unique SES fields from DotHill enclosures (RPM legend, vendor-unique fields, Help & Threshold).
- SES dump now incorporates ASCII text from SES description page, if data is available from enclosure.
- Added **-z** option to report physical disk status of drives behind supported LSI, SGI, and IBM RAID subsystems. This option also reports significant amount of additional controller information with -I+ option.
- IDE disk drive temperature threshold monitoring available on some Maxtor IDE disks.
- The **-Q** option to dump partition information added to SPARC and X86 Solaris release.
- Windows release EMAIL engine now reports more descriptive error message if problem found sending email.
- Made minor text change in ASCII text portion of system-generated threshold monitoring file. Stated if threshold set to zero, the selected value will ALWAYS get reported every polling period. This reflects program behavior.
- Removed redundant "X" character from system-generated threshold files.
- Fixed text on SES page descriptions (-EH option) where Pages 3-5 had wrong page description.
- Added new option (-EP2) to provide full SES control page programmability.
- All mode page editing functions for the "**saved** 80" (non-volatile) page have been disabled for evaluation builds.
- Added -p option to DISABLE SMART for all SCSI & FC disk drives. (It can not be used with the -P flag).
- Fixed problem where SES enclosures that present themselves as a target device did not get polled if using just the **-E** option.
- Fixed buffer overflow problem unique to LINUX that would prevent the additional information shown with the I+ command if command line combined with -S option on IDE disk drives if there are more than 522 entries returned by examining /dev/hd* list.

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- Added **-O** 74 option to display advanced SMART ATA/SATA error log information. Only supported on LINUX today (waiting for MSFT O/S patch before it can be added to Win2K/XP/2003.
- (1.23A): Fixed SPARC-Solaris problem that caused program to crash when invoked with **-Z** 198 option to view disk state behind Mylex family RAID engines.
- (1.23B): Fixed problem that prevented **-str** 108 option from sometimes displaying status of a SCSI/Fibre channel disk drive self-test.
- (1.23B): Enhanced threshold monitoring (**-K** 158 & **-W** 158) so that it no longer concurrently configures and polls S.M.A.R.T. disks.
- (1.23C): When reporting status information for array type 35 elements, the program incorrectly assumed that all elements were the same type. If you had both disks and tapes in an enclosure that reported array status information, it reported all devices as disks. The same happened when reporting threshold information.
- (1.23C); Function -fchbainfo added that reports fibre channel HBA drivers, BIOS level, model number info (requires SNIA API library 230)
- (1.23C): Function -fciostat added that reports fibre channel I/O activity (requires SNIA API library 230)
- (1.23C): Added additional information to **-fc** 128 reporting (HBA_GetRNIDMgmtInfo data)
- (1.23C): Various small cosmetic changes to better present information when a particular HBA reports -1 or invalid data for an unsupported library call.
- (1.23D): Refreshed vendor-unique log page information for all SCSI & Fibre Channel Seagate disk drives. Added models ST373453FC, ST318453FC, ST336742FC, ST336732L*, ST318452L*, ST318432L*, ST318418*
- (1.23D): LINUX-specific fix added to support discovery of back-end disks when using zero-channel RAID controllers. This is done by directly adding the /dev/sgn entry to command-line that corresponds to the disk drive. If you have 5 SCSI disks, you would add /dev/sg[0-4] to the command-line.
- (1.23D): Integration of HP SNIA API logic to executable and installation script. This uses standard libHBAAPI runtimes bundled with HPUX
- (1.23D): Fixed problem in SAF-TE decoding that assumed temperature was reported in degrees F if reported in degrees C for some devices.
- (1.23D): SES now also reports SES firmware revision.
- (1.23D): SPARC Solaris & LINUX builds now use a customized libHBAAPISANtools.so (included) to resolve issues which appear when your system has several HBAs installed from multiple manufacturers.

Version 1.22 (Released August 2003)

- The partition dump feature, **-Q** 19, previously limited to SCSI & fibre channel disk drives, now works with all random access devices, regardless of the interface. It is still limited to Windows and LINUX platforms. Also made a cosmetic change to the output for better readability. After each item, the program printed a space followed by a comma. This was changed to a comma followed by a space.
- A feature to read raw blocks (**-read** 103) was added.
- Fixed a problem that caused extraneous text to be entered into the system event log if you ran the program with the **-link** 63, **-Q** 19, or a **self test** 105 option.
- If you had an ATA-1 or ATA-2 compliant disk drive, the program previously did not display this information. (ATA6 and ATA7 disk drives are current revisions).
- A feature to flash drive firmware (**-flash** 47) was added. This only supports Seagate SCSI & Fibre Channel disk drives today.
- Leading zeros were removed from the output of the **-S** 72 command, which returns S.M.A.R.T. thresholds for ATA disks (the feature is only applicable to Windows & LINUX releases).
- Changed "Preformance" to "Performance" in output from **-S** 158 command.

Version 1.21 (Released July 2003)

- Fixed problem where if device was selected for polling, but not pollable (i.e., not ready), program might crash or lock up.
- The mpimport function would stop importing pages if the selected page completed but returned with non-zero sense information. This would be rare, but could happen if device responded with a recovered error condition.
- The -B (mode page editor) function now tolerates a leading bit, i.e., 9C instead of 1C for the mode page field. This would happen if one was to just dump the single mode page out, make a change, and pipe it back. Some, but not all devices would automatically ignore this bit. By clearing it for you, it is easier to automate a script to change individual pages.
- The -Y option (dump defect details) was added. Due to O/S limitations, only the first 4094 defects can be displayed

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when using the /dev/sg driver. If you use the /dev/sd class driver, you are limited to the first 510 defects, which is rarely enough for large disks.

- The software now reports a disk is dead if it responds with ASC=40 or 44 on SMART queries. This would generally happen some time after a predictive S.M.A.R.T. error was reported, and the drive has failed to the extent that it cannot run predictive tests. The drive would have to be replaced at this point because data loss is assured.
- An enhancement was made if you ran the -F nn option in combination with any dumping option which would ordinarily cause the program to display some information and exit. The program now pauses nn seconds before returning the command prompt. This was done to facilitate providing you with a controlled delay if you are using smartmon-ux in a script like smartmon-ux -F 60 -S would previously just display statistical totals and immediately exit. Now it will display statistical totals and exit after 60 seconds. If you were using windows and had a batch file run smartmon-ux in a loop, this would provide convenient method to give you a 60-second delay. (Windows does not have a sleep function for the command interpreter or batch file scripts).
- Reporting and decoding of data on mode page 19 (protocol specific page) added. If you have a Parallel SCSI device, the program will also report and decode additional data on sub mode pages 1,2,3 and 4. This represents several dozen new fields.
- -link 63 option added to report link speed (mode page 19 support for device required).
- If you are running LINUX, you may also use the "sg" class driver to interface with a device. The advantage of using the sg driver is that it will allow up to 32KB of data to be passed between the program and the device (only needed with -Y option 32 for now). The disadvantage is that the sg driver, due to LINUX bugs, can lock up if the device is not ready.
- Support added for several SATA to FC JBOD subsystems using Xyratex-manufactured enclosures.
- Detailed SCSI inquiry (-I+) option now reports all fields up to SCSI-3, SPC-3 Revision13 (May 2003).
- Detailed SCSI inquiry (-I+) now takes into consideration the SCSI compliance level, and only reports fields specific to that level. For example, if device is ANSI level 2, it will not report ON/OFF level for a feature introduced at ANSI level 3. Conversely, it will not report a field which might have been undefined or obsoleted at an earlier or later SCSI revision.
- mpimport now works significantly faster, as it first reads the mode page and determines if it needs to be reprogrammed before issuing a change.
- If an unknown version descriptor is reported by the device (-I+), the program now reports the hex code rather than "(null)". This would happen if you are running and old version of the code on a device that introduced new version descriptors that are unknown to the program. In this way you can at least see the hex code and cross-reference against the latest ANSI specification.
- Additional details added to self-test results. The number of power-on hours returned by the device at the time of the test, or at the time the test failed is reported. If the self-test failed, then the segment number on the device where the test failed is also reported.
- Protocol-specific port page (mode page 18) is now reported and decoded.
- The SCSI time-out time was increased in order to provide sufficient time to report defect information with 181 GB and larger SCSI/Fibre channel disk drives.
- If the disk does not support reporting number of factory defects, the program now reports "unsupported", and attempts to return number of grown defects. Previously the program would not report grown defects if factory defect reporting was unsupported by the device.
- S.M.A.R.T. testing now incorporates additional tests in case drive is failing, but it does not return proper response codes to S.M.A.R.T. tests.
- Fixed problem where Request/Ack data transfer support on -I+ option was incorrectly just returning whether or not the device supported SES.
- 32-bit parallel support always printed if ANSI level <= 3, now it prints if ANSI level <=2 and if SPI level is >= 2
- 16-bit parallel support now reports in the same manner as above.
- On SES reporting, if a particular element reported status as "not found or unavailable", it still attempted to read and report the value. For example, if a device reported there were 2 temperature elements, but only one of them was installed, it would incorrectly report the temperature as being -20 degrees. This bug did not, however, cause any alerts to be generated.
- If mode page 1C was not supported on a disk device, the program would not attempt to report SES status.
- Fixed typo on Tape control mode page #10 (*permanent* changed to *permanent*).

Version 1.20 (Released June 2003)

- Added SCSI Enclosure Services (SES) capability to control fault & identification indicators for devices in selected

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slots.
- Added SES capability to control audible alarm(s).
- Added full SES hex dump of all control/status pages, so vendor-specific information can be reported.
- Rewrote SES polling engine so it can extract information from enclosures much more quickly. Basically many enclosures need small delays between status and control requests. If the controller was not ready to respond, the operation would either time out or return junk data, and smartmon-ux would have to retry after a 2-second delay. Now the program adds 50 millisecond delays between requests which almost always insures that no retry will be required. This has result of operations typically being performed in well under a second, rather than a range of 5 - 10 seconds.
- Added decoding for over 100 vendor-specific fields for XYRATEX family enclosures (Goshawk, Phoenix, and Osprey). Many of these new fields are only reportable if using LRC firmware revision 34 or higher.
- Added ability to import & export all or some mode pages for a selected device. The -mpexport 95 command saves all mode pages in human & smartmon-ux readable format in a user-defined file. The user can then issue the -mpimport 98 command against one or more devices to program new mode pages. In addition, the user can edit the data file and comment out specific bytes and/or pages before uploading to new devices.
- As more options have been added, the program is now case sensitive to command-line options. As the program has always documented upper-case for options, it is our hope that this will not cause customer scripts to break.
- Fixed 4 typos in log & mode page output.

Version 1.19 (Released May 2003)
- Eliminated a retry if an invalid command was sent to a device where resulting key was 5, and ASC was not equal to 24.
- Fixed problem when program running in debug mode where the sense key was not always returned to the operator.
- IBM AIX 5.x support added

Version 1.18 (Released April 2003)
- Added 106 new log entries for LSI-based RAID storage subsystems.
- Fixed OSX-Specific problem with discovery, where it would not discover a disk at LUN0.
- Added attribute descriptions for IDE SMART attributes #6,11,13
- LINUX/Windows specific fix to add description "ID ATA-4 X3T13 1153D rev18" for appropriate IDE disks.
- Fixed LINUX-only problem where firmware rev on IDE disks displayed backwards.
- Added -help option, in case user was running a shell that "absorbed" the -? option.

Version 1.17 (Released March 2003)
- Switched to "no rewind" type drivers, i.e., /dev/rmt/0mn for tape polling. This prevents a tape from being rewound under LINUX at polling time because of a poorly written device driver. Note that this problem could have appeared under other operating systems, but was not reported to us as a problem until now.
- Fixed problem introduced in 1.16E where carriage returns used in interactive mode did not default to value shown as default in prompt.
- Fixed another issue with parsing command line options, only reported in Apple however, where commands with "+" value, i.e, -I+ caused next command option to be ignored.
- Program no longer automatically attempts an automatic retry on an invalid CDB.
- Documented issue where -W option must NOT be followed by a space before the filename.
- Better error handling in event invalid options are supplied. Program now gives you specifics on what is the problem, rather then dumping command-line options usage to screen.
- Changed html documentation so Javascript is not used. Found incompatibility problem with browser on Apple OS X)
- Added additional Mylex RAID controller event entries introduced in FW 9.02.

4.8 System Event Log

This software logs nearly all actions and polling results in an O/S-specific event log. It passes the messages to the standard UNIX/LINUX syslog function or the Windows ReportEvent API, depending on what operating system you are using. Alternately you can add the -L function is added to the command-line and have your messages recorded into a file specified by the table below.

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All log entries are made by opening, appending, and closing the file. If the log file is busy, the software will sleep for 100 ms then retry up to 100 times before giving up and moving on. This insures that multiple instances of the software will not corrupt the log file.

O/S-Defined Event Log File Name

Operating System	**-L** Log file
LINUX	`/var/log/smartmon-ux`
SPARC Solaris	`/var/log/smartmon-ux`
X86 Solaris	`/var/log/smartmon-ux`
Apple OS X	`/var/log/smartmon-ux`
UNIXWare	`/var/adm/smartmon-ux`
IBM AIX	`/var/adm/smartmon-ux`
HP HP/UX	`/var/adm/smartmon-ux`
SGI IRIX	`/var/adm/smartmon-ux`
HP (DEC) Tru64	`/var/adm/smartmon-ux`
HP (DEC) OpenVMS	`SMARTMON.LOG (in current directory)`
Windows	smartmon-ux.log in the "current" directory when the program was invoked. Note: If you invoke software from a batch (.BAT) file, you should CD to the desired log file directory before you invoke the software. If the program is running as a service, then the log file will be saved in the same directory where the program is installed.

Event Log Priority

Depending on the type of event, the software will classify log messages as Success, Information, Error, Critical, and Warning. These correspond to standard priorities supported by the UNIX/LINUX syslog. (The Windows event logger does not differentiate between a critical error and a non-critical error).

Event Log Localization

If the **-i** 63 flag is added to the command-line, all events will be prefaced by the date and time in the local language, provided your operating system also has localization enabled. Localization is supported on all operating systems, including Windows, if it is enabled. If you do not use the **-i** 63 option, all messages will be prefaced by the date an time in US English format.

Sample event log entries (data sent with the -L flag)

Fri Mar 25 23:13:57 2005: ./smartmon-ux started
Fri Mar 25 23:13:57 2005: Discovered SEAGATE ST336706LC S/N "3FD010DD" on /dev/sdb (SMART enabled)(35003 MB)
Fri Mar 25 23:13:57 2005: /dev/sdb polled at Fri Mar 25 23:13:57 2005 Status:Passed
Fri Mar 25 23:14:07 2005: /dev/sdb polled at Fri Mar 25 23:14:07 2005 Status:Passed

Windows-Specific Event Log Information

SANTOOLs software utilizes the standard ReportEvent API for reporting events. They appear as uncategorized Application Log entries. The event source will always be "smartmon-ux". Event IDs will be 8000 - 8003 which correspond, in order, to Success, Information, Warning, and Error. The full text of the message will appear in the log, but there will be no redundant leading date/time information. This is because the operating system will assign the date/time as the event is posted.

One of the enhancements introduced in release 1.29 was that you can add *hostname* in order to specify logging events on a remote host. You must, of course, have proper permissions. Hostname must be entered in the Universal Naming Convention (UCE) format. This is also known as the Uniform Naming Convention, or just NETBIOS name. This should not be confused with the IP based-hostname. Example: **`-LRemote \\MAILSERVER3`**. You may also use the IP number, as in **`-LRemote 192.168.1.245`**

Firewall Restrictions

If you use the **`-LRemote`** function to send messages to a remote host, you must make sure that you open up UDP

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port #514 between the remote host that will receive the events, and the local system that is generating them via this software. This port is closed by default with the native firewall in Windows XP SP1.

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